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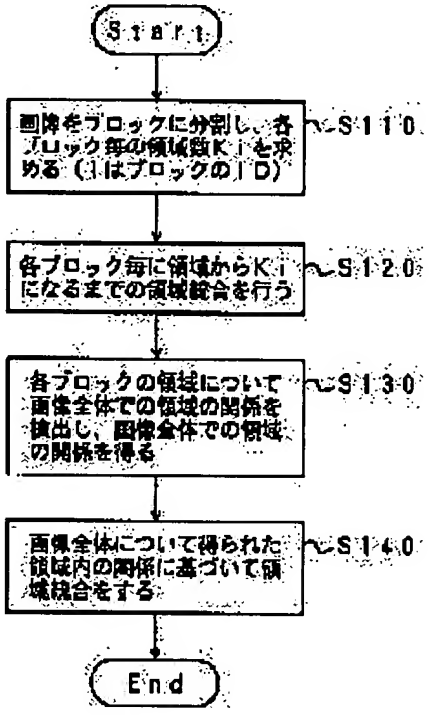
(54) IMAGE PROCESSING METHOD

(57)Abstract:

PURPOSE: To perform processing by a computer with small storage capacity by dividing an image into necessary units and integrates areas as to their constituent pixels, putting images of respective units together into one screen image as an initial cluster, and coupling areas as to the cluster.

CONSTITUTION: One image is divided into divided areas of easy-to-process size and the number of pixels to be processed is decreased to facilitate the handling (S110). Then the individual divided images are hierarchically clustered (S120). Then all the divided images are put together and handled as one image, i.e., the initial cluster, which is hierarchically clustered (S130 and S140). At this time, the history of the integration is saved together with color component information on the current cluster. The history of integration is traced back to know and extract a cluster having information on a desired color component, thereby dividing a desired area part from the image.



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CLAIMS

[Claim(s)]
[Claim 1] The 1st field integrated down stream processing which divides the image of a processing object into a necessary unit, and carries out field integration of the beam image about that configuration pixel at this rate at a unit, While considering as the image for one screen which collects the image of each above-mentioned unit acquired by this 1st field integrated down stream processing, and makes these an initial cluster and performing field integration about the cluster of this image The image-processing approach characterized by consisting of the 2nd field integrated down stream processing which saves integrated hysteresis.
[Claim 2] The 1st field integrated down stream processing which divides the image of a processing object into a necessary unit, and carries out field integration of the beam image about that configuration pixel at this rate at a unit, While considering as the image for one screen which collects the image of each above-mentioned unit acquired by this 1st field integrated down stream processing, and makes these an initial cluster and performing field integration about the cluster of this image The image-processing approach characterized by consisting of the 2nd field integrated down stream processing which carries out information preservation that the hysteresis information on field integration should be managed by the binary tree.
[Claim 3] claims 1 or 2 characterized by for field integration having adjacency and unifying it preferentially from the cluster of dissimilar [on a color space] whenever min -- either -- the image-processing approach of a publication.
[Claim 4] claims 1 or 2 characterized by managing by the binary tree while saving the integrated hysteresis including the information showing the sequence of field integration, and the similarity between the fields by which field integration was carried out, and the coordinate information on the cluster integrated of the cluster integrated -- either -- the image-processing approach of a publication.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is concerned with the image-processing approach, and relates to the image-processing approach for dividing especially image data for every field which has a certain description.
[0002]
[Description of the Prior Art] In fields, such as printing, a photograph, and pictures, the lightness, the hue, the saturation, the coordinate, etc. of an image (location) are caught synthetically, and the part of an image is classified like "a light, middle, and a shadow" in many cases. And since this specifies the part which has an image in the condition referred to as "Being to a pan about a person's "light"" etc. in the proofreading phase of the photograph showing a person, the concept of these "lights, middle, and shadows" is used. And in leaving division decision of "a light, middle, and a shadow" to decision of an operator individual chiefly, and making this judgment, an operator will take into consideration synthetically the lightness, the hue, the saturation, the coordinate, etc. of an image.
[0003] By the way, in fields, such as printing, the manuscript image was processed more often by computer in recent years. Therefore, it is desirable that extract processing can be similarly carried out automatically by computer about the classification of "a light, middle, and a shadow." As general technique available when a computer extracts a certain field in an image, there are "an approach of performing field division for the image which has a concentration difference using a predetermined threshold", "a method of performing field division using the threshold determined by histograms, such as concentration or a chromaticity,", "a method of considering that the edge of an image is the boundary line of a field, and performing field division", etc.
[0004] However, no image-processing approaches of these former catch synthetically each element, such as lightness of an image, a hue, saturation, and a coordinate, judge only one element as an object, and perform field division. Therefore, the field divided by the conventional image-processing approach will become a different thing from the field by the concept of "a light, middle, and a shadow." That is, by the image-processing approach mentioned above, even if it is going to apply an image to a concept like "a light, middle, and a shadow" and is going to divide it, field division which suits recognition of human being cannot be performed.
[0005] Moreover, if it notes that a hierarchy is in division and a classification of "a light, middle, and a shadow", applying a hierarchical-cluster-analysis method to an image, and dividing and classifying each field of this "light, middle, and shadow" will also be considered. However, the following problems arise in this case.
[0006] It is a point referred to as having to calculate the distance on the color space about all pixel pairs, and having to find out the cluster pair of the minimum distance from this inside, in order to perform hierarchical clustering (hierarchical field division). For this reason, if the number of pixels increases, the number of cluster pairs made applicable to count will turn into a huge number, and the processing time and the memory space to need will become huge.
[0007] although all several n pixels are set to n=512x512=262144 if for example, the number of pixels is in the image data of 512x512 -- a number with a combination [of a pixel pair] of these 262144 pixels, and nC 2 = 3.436x106 It becomes. And in order to hold such a huge number of data, the bulk memory of about 200 to 400 GBytes is needed.
[0008] Moreover, the number of the pixel pairs about a several n pixel Since it is expressed with nC2 =n (n+1) / 2, it can check that the number of pixel pairs used as the candidate for an operation increases in proportion to the square of a several n pixel. therefore, in order to process by computer using the approach of starting, too much huge computation time and huge memory space are needed -- things -- since -- for applying to the processing which cannot apply to clustering for a highly minute image, but is divided into each field of the above "lights, middle, and shadows", it is unsuitable.

[0009] Therefore, each conventional image-processing approach is unsuitable for applying to the processing which divides an image into each field of "a light, middle, and a shadow." then, **** which this invention person shows to Japanese Patent Application No. No. (it is hereafter called the advanced technology) 340077 [five to] in order to solve these problems -- the hierarchical field extract approach was proposed. This approach is explained below.
[0010] [Description of the Prior Art] [I], i.e., technique applied to this advanced technology The similarity of two fields where it is contrasted in image data is computed based on the coordinate of the two fields concerned on a color space, and similarity with the field concerned of 1 carries out sequential integration of other fields used as max to the field concerned of 1 among two or more of other fields contiguous to the field of one in the above-mentioned image data.
[0011] [II] In addition to processing of above-mentioned [I], the historical data which express further the sequence of field integration and the similarity between the fields by which field integration was carried out are generated again, and sequential division of the field pair of the similarity of the predetermined range is carried out by the sequence and the reverse order of field integration among the image data by which field integration was carried out according to the above-mentioned historical data.
[0012] The approach of [I] computes the similarity of two fields (cluster) where it is first contrasted in image data based on the coordinate of the two fields concerned on a color space among these. Similarity becomes large when the chromaticity of two fields etc. approximates this result of an operation. And similarity with the field concerned of 1 carries out sequential integration of other fields used as max to the field concerned of 1 out of two or more of other fields contiguous to the field of one in image data. Consequently, the fields which the chromaticity approximated will be unified and contrast between fields can be made high enough.
[0013] Moreover, by the approach of [II], the similarity of two fields where it is contrasted in image data is first computed based on the coordinate of the two fields concerned on a color space. And similarity with the field concerned of 1 carries out sequential integration of other fields used as max to the field concerned of 1 among two or more of other fields contiguous to the field of one in the above-mentioned image data. At this time, the historical data showing the sequence of field integration and the similarity between the fields by which field integration was carried out are generated. And according to the above-mentioned historical data, sequential division is carried out among the image data by which field integration was carried out by the sequence and the reverse order of field integration of the field pair of the similarity of the predetermined range. That is, since the image data by which field integration was carried out is again divided for every field which the description approximated to some extent, it can extract a desired field out of image data.
[0014] Furthermore, the detail is explained. The outline of the hierarchical clustering adopted in the advanced technology here is explained first. The hierarchical clustering in the advanced technology is processing referred to as performing field division of an image by carrying out sequential integration of the fields (cluster) which the descriptions, such as a hue, lightness, and saturation, approximate (that is, similarity is large).
[0015] According to the technique referred to as carrying out sequential integration of the large fields of this similarity, it becomes possible to have said that it divided into the field of a person and a background about the given image. Suppose that the data (image data) of the color picture of the n pixel configuration which becomes the image processing system (computer) which adopted the technique of the advanced technology from an object and a background were given. Then, in this image processing system, processing which carries out that a part for a background and a person part carve by making the coordinate point on the color space of each pixel in n-pixel image data into an initial cluster will be advanced.
[0016] n clusters on a color space make two distribution which solidified corresponding to the pixel showing a background, and the pixel showing a person. Then, other clusters near the chromaticity of the cluster concerned are discovered on a color space, and it is made to unify in the advanced technology paying attention to the cluster of one in n initial clusters which constitute a screen. That is, an image processing system calculates the chromaticity of the cluster of 1, and all other clusters etc. by the coordinate on a color space, and discovers other clusters which the chromaticity approximated.
[0017] Thus, the detected cluster pair becomes what the hue in a real image, lightness, saturation, etc. approximated mutually. Therefore, this detected cluster pair is unified. By unifying this detected cluster pair, the number of clusters becomes n-1 piece. Although this processing is repeated and performed, the number of clusters will become fewer gradually if sequential integration of the clusters which the chromaticity approximated is carried out, and the number of clusters finally becomes one piece, when the number of clusters becomes two pieces in the process of field integration of an image processing system, field integration is stopped here.
[0018] It means classifying each pixel of the given image into two clusters according to stopping field integration in this phase. Thus, although the chromaticity approximates mutually the pixels which constitute the same cluster if two

obtained clusters are looked at, as for the pixels between different clusters, chromaticities differ greatly. That is, it means that image data was divided into two groups from whom the description differs. The above processing enables it to divide an image into two fields, a part for a background, and a person part.

[0019] Drawing 15 is the conceptual diagram of image data and field integrated processing. The sign 21 in drawing 15 shows the part of the inputted image data (9 pixels). Moreover, drawing 16 is L* a* b*. It is drawing showing the image data on a color space. If it is in the advanced technology, it judges as follows whether a certain pixel (cluster) 210 and which [other] pixel are unified, for example.

[0020] First, an image processing system discovers other pixels (about 4 (four pixels which consider a pixel as a rectangle and touch on all sides [of a view pixel]), and about 8 (a total of 8 pixels of four pixels which touch on all sides [of a view pixel], and four pixels which touch the diagonal location in a view pixel)) which adjoin the pixel (it is hereafter called a view pixel) 210 which exists the account of a top. That is, only the pixels which adjoin to the view pixel 210 are the view pixel 210 concerned and an object pixel which can be integrated.

[0021] And an image processing system discovers the pixel from which a contrast scale value on the strength serves as min among other pixels which adjoin the view pixel 210 (similarity serves as max). A contrast scale value on the strength is L* a* b* so that it may mention later. When field integration is carried out on a color space (drawing 16), the distributed value change of a cluster is expressed.

[0022] L* a* b* A color space is uniform color space and the distance on this space has become the difference of the chromaticity on vision with what carried out proportionally [abbreviation]. Namely, L* a* b* That the contrast scale value on the strength in a color space is small means what the chromaticity of a cluster pair etc. approximates (similarity is large), and it means the difference (similarity is small) in the chromaticity of a field pair etc. that a contrast scale value on the strength is large.

[0023] For example, L* a* b* In a color space, the size of a contrast scale value on the strength is investigated about each pixel of the perimeter to the view pixel 210. Consequently, supposing the contrast scale value on the strength which a pixel 211 has to the view pixel 210 is min, an image processing system will perform field integration with the view pixel 210 and the pixel 211 of this contrast scale value min on the strength. And after this finishes, such processing to this view pixel 210 integrated is repeated again. Whenever it repeats such processing, sequential integration of what were approximated [chromaticity] will be carried out by the thing of contrast scale value min on the strength of the inside for [in the time] a comparison being unified by the view pixel among adjoining pixel (cluster) pairs, every one pixel (cluster) pair will decrease, and, finally the nine original pixels will be summarized to one cluster (field).

[0024] In order to perform efficiently hierarchical clustering processing mentioned above, in the advanced technology, data processing by the so-called graph structure is performed. That is, it considers that the pixels (cluster) which constitute image data are top-most vertices, and is L* a* b*. It considers that the contrast scale value on the strength between the pixels (cluster) in a color space is the side, and the similarity between each field and each field etc. is treated as a graph. When these whole top-most vertices and whole side are regarded as a graph, processing of hierarchical clustering will constitute the so-called tree (tree). Below, the various DS in this image processing system is explained, referring to drawing 18 - drawing 21 .

[0025] Drawing 18 expresses the data 50 of top-most vertices, and the neighboring data 51. The data 50 of top-most vertices express the information on a cluster, and are constituted by the following data. In this drawing, although a label 501 should just be the notation of a meaning in a graph, it expresses with this advanced technology the coordinate on the real image of the cluster which is top-most vertices (x y). For example, when 16 bits of high orders of the 32-bit data are made into a y-coordinate value and 16 bits of low order are made into an x-coordinate value, a label 501 is expressed like yx65536+x. Moreover, it is also possible to set width of face of an image to w, and to express a label 501 like x+yxw.

[0026] L* The average 502 and a* The average 503 and b* The average 504 is L* a* b* about each pixel in a cluster. The average of each coordinate in a color space is expressed. The measurement size 505 expresses the total number of pixels which constitutes a cluster. The pointer 506 to a list expresses the address of the list data 60 placed on the memory in a computer. Moreover, the list data 60 consist of a pointer of neighboring data, and are later mentioned about this (drawing 19). The pointer 507 to a binary tree expresses the node of the binary tree showing the top-most vertices before integration. That is, the data of a binary tree express the integrated hysteresis of a cluster as data of a tree structure.

[0027] The neighboring data 51 are constituted as follows. The contrast scale value 511 on the strength is L* a* b* between the top-most vertices (cluster) in neighboring both ends. The distributed change on a color space is expressed. That is, the contrast scale value 511 on the strength is L[assuming that two clusters contrasted were unified / before

and behind integration] * a* b*. The distributed value change of the cluster on a color space is expressed.
[0028] Therefore, it is saying that saying, "A contrast scale value on the strength is small" has few distributed value changes at the time of unifying two clusters, and means saying that the chromaticity of this, i.e., two clusters, approximates (similarity is large).
[0029] On the contrary, it is saying that saying, "A contrast scale value on the strength is large" has a large distributed value change at the time of unifying two clusters, and this means saying that the chromaticity of two clusters is different (similarity is small) despite a join office. In addition, in case a contrast scale value on the strength is computed in drawing 16 according to the formula of the contrast scale value dpq on the strength, it is L* a* b*. Weighting may be made each component.
[0030] The pointer 512,513 to the data of the top-most vertices in the neighboring data 51 shows the address of the data of the top-most vertices of neighboring both ends. Therefore, it becomes possible by referring to the neighboring data 51 to judge easily the connection relation of a cluster, and the similarity between each cluster.
[0031] Drawing 19 expresses the relation of the list data 60, the data 50 of top-most vertices, and the neighboring data 51. The data 50 of the top-most vertices of this drawing and the neighboring data 51 are things as mentioned above, and the list data 60 consist of pointers 601 in which the address of the neighboring data 51 is shown. Therefore, it becomes possible by referring to the list data 60 to grasp the connection relation between the side and top-most vertices. Moreover, by referring to the pointer 512,513 in the neighboring data 51, the data 50 of two top-most vertices in neighboring both ends can be discovered, and the list data 60 can be discovered by referring to the pointer 506 to the list of [in the data 50 of top-most vertices].
[0032] Drawing 20 expresses the data 50 of top-most vertices, and the node data 70 of a tree structure. The information at the time of unifying two top-most vertices (cluster) is included in the node data 70, and some data of a binary tree are constituted. A label 701 is a label of the top-most vertices after integration, and is used as either of the labels of two top-most vertices before integration with this advanced technology.
[0033] L* The average 702 and a* The average 703 and b* The average 704 is the average of each color component after unifying two clusters. That is, it is L* which weight averaged the value of each color component according to the total number of pixels of each cluster. The average 702 and a* The average 703 and b* It is the average 704. The contrast scale value 705 on the strength is L* a* b* at the time of unifying two clusters, as mentioned above. The distributed value change on a color space is shown.
[0034] The pointer 706,707 to a sub tree points to the node data 70 integrated. Thus, the process of field integration can be grasped by following the node data 70 which make hierarchical structure.
[0035] Drawing 21 is drawing showing B-tree (tree). This B-tree 80 is used in order to search lists 81-86 and the data of the side of -- which serves as min of a contrast scale on the strength from inside by using a contrast scale value on the strength as a key (retrieval item). That is, a chromaticity becomes possible [searching a most similar thing with very little memory access] by referring to this B-tree 80 out of the side which connects a certain top-most vertices (cluster) and other top-most vertices contiguous to these top-most vertices.
[0036] In this drawing, the pointer indicating the address of the neighboring data 51 is written in lists 81-86 and --, and the data 51 of the side shown with the pointer of the same list have the same contrast scale value on the strength. These pointers are located in a line corresponding to the ascending order of the contrast scale value 511 on the strength in the neighboring data 51. Therefore, it can look for the data 51 of the side where a contrast scale value on the strength serves as min by investigating the pointer registered into the top list 81, and discovering the data 51 of the side which this pointer shows. In addition, when two or more sides where a contrast scale value on the strength becomes the same exist, two or more pointers are registered into the same list.
[0037] The node of the root in the B-tree 80 consists of four keys 811-814, there are five pointers 821-825 before and after each key further, each pointer points out one node, and, as for each key, one list is pointed at. These are making the layered structure as a whole. Data are further divided and assigned to each node by which data divided, were assigned and were connected to each of these pointers like a key with them, --, a larger key than a key 814. [five pointers 821-825 of a root larger than a key smaller than a key 811, a larger key smaller than a key 812 than a key 811, a larger key smaller than a key 812 than a key 812, and a key 812, and] [respectively smaller than a key 813]
[0038] Therefore, it can look for the list 81 of pointers to the neighboring data in which the minimum contrast scale value on the strength is shown by following the top node 801,802,803 for each class. In addition, the B-tree 80 is equipped with the advantage of a list 81 and -- which says that an addition and deletion are easy.
[0039] Moreover, when two or more contrast scale values on the strength are registered into the same list, even if one of these is deleted, that key is not deleted until a list becomes empty. That is, since the B-tree 80 always maintains equilibrium, the high-speed retrieval of it is attained.

[0040] [The example of the hierarchical clustering processing in the advanced technology], then the hierarchical clustering processing in this advanced technology, i.e., processing until it unifies each cluster to one cluster, are explained. Drawing 17 is a flow chart showing processing of the field integration in this advanced technology. Image data is first inputted into the image processing system by the computer which applied this advanced technology, and an image memory is made to memorize this. Here, suppose that the image data 21 shown in drawing 15 was inputted. Although actual image data has many pixels farther than this, in order to talk brief here, explanation is advanced for the image data 21 of the pixel of 3x3 to an example for convenience.

[0041] In step S41, a processor generates the so-called grid graph based on image data 21 by computing the data 50 of top-most vertices, the neighboring data 51, and the node data 70 (step S41). It is the subroutine of steps S411 and S412 which expressed processing of this step S41 to the detail.

[0042] Next, in step S411, the data of the top-most vertices about each pixel of image data 21 are computed first. The data 50 of top-most vertices are a label 501 and L*a* b*, as mentioned above. It is constituted by the averages 502-504 of each color component in a color space, a measurement size 505, the pointer 506 to a list, and the pointer 507 to a binary tree. In addition, at this time, since field integration is not performed, a label 501 serves as a coordinate value on the image data of each pixel, and a measurement size 505 is set to "1." Moreover, the averages 502-504 of each color component are L* a* b* for every pixel. It becomes a coordinate value on a color space.

[0043] Furthermore, a processor registers the node data 70 of a binary tree about each pixel. At this time, since field integration is not performed, the so-called subtree does not exist, but therefore, the pointer 706,707 to a subtree serves as a blank (zero). Moreover, the contrast scale value 705 showing change of distribution of a cluster on the strength also serves as a blank (zero).

[0044] Next, it moves to processing of step S412. In this step S412, the neighboring data 51 are computed in the following procedures. First, a processor is L* a* b* between this view pixel 210 and the pixels (about [for example,] 4) 211-214 which adjoin this pixel 210 paying attention to the pixel 210 in image data 21. The contrast scale value on the strength on a color space is calculated.

[0045] That is, a processor is L* a* b* in the top-most-vertices data 50 computed at step S411. It is based on each color components 502-504, and change of distribution of each color component 502-504 between each pixel of the view pixel 210 and pixels 211-214 is investigated. And change of these distributions is registered into the data 51 of the side of the view pixel 210 as a contrast scale value 511 on the strength. Moreover, the address of the data 50 of the top-most vertices in the both ends of the side of the view pixel 210 is written in the pointer 512,513 of the neighboring data 51. Thus, the data 51 of the four sides in this view pixel 210 centering on the view pixel 210 are generated.

[0046] Thus, the data 51 of the generated side are registered into the B-tree 80 of drawing 21 with the pointer to the information on the key for the retrieval (retrieval item), and neighboring data. That is, a processor is registering the pointer of the neighboring data 51 into order with a small contrast scale value on the strength, and a list 81 and -- complete it. The initial grid graph which consists of data of top-most vertices and the side is completed by processing of the above steps S411 and S412 (step S41).

[0047] After this finishes, it judges whether the total number of clusters was set to "1" (S42). Since field integration is not performed at this time, the number of pixels turns into the total number of clusters as it is. Therefore, since the total number of clusters is not "1", the decision result of step S42 serves as NO, and the following detection processing of a cluster pair (side) of contrast on-the-strength min is performed (step S43). That is, they are the contents referred to as processing at step S43 withdrawing a list 81 in advance by searching a list 81 and the data 51 of the side where a contrast scale value on the strength serves as min from inside of -- with reference to the B-tree 80 if retrieval is completed, or it issuing it the back, or deleting it from the whole list according to a certain convention.

[0048] Retrieval of the data 51 of the side used as the min of a contrast scale value on the strength performs processing which unifies the top-most vertices located to the both ends of the data 51 of this side next (step S44). For example, supposing the contrast scale value of the view pixel 210 and a pixel 211 on the strength is min, integration with the view pixel 210 and a pixel 211 will be performed. In connection with this, a processor also carries out the data 50 of top-most vertices, the neighboring data 51, and renewal of data 70 grade of a binary tree.

[0049] An update process of the data 50 of top-most vertices reads the data 50 of two top-most vertices corresponding to each of the pixel 210,211 integrated in step S43, and is performed by unifying the data 50 of one of top-most vertices to the data 50 of the top-most vertices of another side.

[0050] For example, suppose that the data 50 of the top-most vertices concerning the view pixel 210 were unified to the data of the top-most vertices concerning a pixel 211. When two pixels 210,211 are unified by one cluster consequently, it is L* a* b* of the cluster after integration. The averages 502-504 of each color component on a color space are changed. Therefore, it registers with the data 50 of the top-most vertices which the average values 502-504 of each

color component in the cluster integrated also require for the view pixel 210.
[0051] The renewal of the pointer 507 to the binary tree in the data 50 of top-most vertices generates the new node data 70 first, and performs the pointer 507 in the data 50 of the top-most vertices of the view pixel 210 here by registering the pointer 507 in the data of the top-most vertices of the pointer 706 of the new node data 70, and a pixel 211 into the pointer 707 of the new node data 70, respectively. Moreover, the contrast scale value 511 on the strength in the data 51 of the side which connects the average value of the color components 502-504 of a pixel 210,211 to the label 701 of the new node data 70, and connects a pixel 210,211 for the label 501 of the view pixel 210 to the new color components 702-704 of the node data 70 again is registered into the contrast scale value 705 of the new node data 70 on the strength, respectively.
[0052] An update process of the data 51 of the above-mentioned side turns into processing referred to as deleting the data of the side about top-most vertices 210,211 from the list 60 of both sides of a pixel 210,211. This from the information which each top-most vertices held overlapping, when two top-most vertices are unified In the phase of the 1st field integration, since the side which is because it is necessary to delete the list data 60 and the data with which it overlapped in the B-tree 80, therefore unifies a pixel 210,211 and which a pixel 210,211 overlaps and connects does not exist, this processing does not have the need.
[0053] Thus, renewal of whenever [dissimilar / to the field newly integrated] is performed about all the fields that adjoin this.
[0054] A pixel 210,211 is unified by the above at one top-most vertices (cluster) 216. Then, return and processing of S42-S44 are repeated and performed to processing of step S42. Thus, suppose that the clusters P, Q, and R which are the phases of field integration of the pixel data 21, for example, have two or more pixels, respectively as shown in drawing 16 were generated.
[0055] In this phase, in the decision routine of step S42, since the total number of clusters still is not "1", the processing which performs field integration of these clusters P, Q, and R continues. That is, since it is "NO" as a result of decision of step S42, it moves to processing of step S43 in order to process field integration of Clusters P, Q, and R, and a processor searches a list 81 and the data 51 of the side where a contrast scale value on the strength serves as min from inside of -- with reference to the B-tree 80 here.
[0056] After retrieval is completed, next, the registration of the searched others is deleted from a list, and if a list is empty, the key will be deleted from B-tree. Retrieval of the data 51 of the side used as the min of a contrast scale value on the strength unifies the top-most vertices in the both ends of the data 51 of this side (step S44). For example, supposing the contrast scale value of Cluster P and Cluster Q on the strength is min, integration with Cluster P and Cluster Q will be performed. In connection with this, the data 50 of top-most vertices, the neighboring data 51, and renewal of data 70 grade of a binary tree are also performed (step S44).
[0057] That is, an update process of the data 50 of top-most vertices reads the data 50 of two top-most vertices corresponding to each of the clusters P and Q integrated in step S43, and is performed by having said that the data 50 of one of top-most vertices were unified to the data 50 of the top-most vertices of another side. And supposing it unifies the data 50 of the result, for example, the top-most vertices concerning Cluster P, to the data of the top-most vertices concerning Cluster Q As a result of two clusters' P and Q being unified by one cluster, it is L* a* b* of the cluster after integration. Since the averages 502-504 of each color component on a color space are changed The average values 502-504 of each color component in the cluster integrated are registered into the data 50 of the top-most vertices concerning Cluster Q.
[0058] moreover, about the pointer 507 to the binary tree in the data 50 of top-most vertices The pointer 507 in the data 50 of the top-most vertices which generate the new node data 70 and start the view pixel 210 first, to the pointer 706 of the new node data 70 The pointer 507 in the data of the top-most vertices concerning a pixel 211 is registered into the pointer 707 of the new node data 70, respectively. The label 501 concerning the view pixel 210 moreover, on the label 701 of the new node data 70 The average value of the color components 502-504 concerning a pixel 210,211 for the new color components 702-704 of the node data 70 It is updated by registering into the contrast scale value 705 of the new node data 70 on the strength the contrast scale value 511 on the strength in the data 51 of the side to which a pixel 210,211 is connected, respectively.
[0059] About the neighboring data 51, the update process referred to as deleting the data of the side concerning top-most vertices 210,211 from the list 60 of both sides of a pixel 210,211 first is carried out. When two top-most vertices are unified, this is because the situation which said that the information which each top-most vertices held will overlap may arise, and deletes the list data 60 and the data with which it overlapped in the B-tree 80 there. However, in the phase of the 1st field integration, since the side which unifies a pixel 210,211 and which a pixel 210,211 overlaps and connects does not exist, such processing does not have the need. Therefore, renewal of whenever [dissimilar / to the

field newly integrated] is performed about all the fields that adjoin this.
[0060] A pixel 210,211 is unified by the above at one top-most vertices (cluster) 216. Then, processing of a processor repeats and performs processing of return and steps S42-S44 to step S42.
[0061] Thus, suppose that the clusters P, Q, and R which are the phases of field integration of the pixel data 21, for example, have two or more pixels, respectively as shown in drawing 16 were generated. Processing of field integration is again performed as follows next about these clusters P, Q, and R.
[0062] First, in step S43, a list 81 and the data 51 of the side where a contrast scale value on the strength serves as min from inside of -- are searched with reference to the B-tree 80. After retrieval is completed, next, the registration of the searched others is deleted from a list, and if a list is empty, the key will be deleted from B-tree. Retrieval of the data 51 of the side used as the min of a contrast scale value on the strength unifies the top-most vertices in the both ends of the data 51 of this side. For example, supposing the contrast scale value of Cluster P and Cluster Q on the strength is min, integration with Cluster P and Cluster Q will be performed. In connection with this, a processor updates the data 50 of top-most vertices, the neighboring data 51, and the data 70 grade of a binary tree (step S44).
[0063] The renewal of the pointer 507 to the binary tree in the data 50 of top-most vertices generates the new node data 70 first, and is performed by making the processing referred to as registering into the pointer 707 of the new node data 70 the pointer 507 in the data of the top-most vertices which start Cluster Q at the pointer 706 of the new node data 70 in the pointer 507 in the data 50 of the top-most vertices concerning Cluster P, respectively. Moreover, the contrast scale value 511 on the strength in the data 51 of the side which connects Clusters P and Q for the average value of the color components 502-504 which start Clusters P and Q in the label 501 concerning Cluster P at the label 701 of the new node data 70 to the new color components 702-704 of the node data 70 is registered into the contrast scale value 705 of the new node data 70 on the strength, respectively.
[0064] An update process of the neighboring data 51 deletes the pointer 601 in which the side PQ to which top-most vertices P and Q are connected is shown first from the list data 60, as shown in drawing 19 . moreover, when the top-most vertices R which both the top-most vertices P and Q connect exist, CPU from the list data 60 about top-most vertices P and Q It is the processing which deleted the pointer 601 of the side QR or the side RP, deleted the data about the side QR or the side RP from the B-tree 80, and was further referred to as merging into it of top-most vertices Q the neighboring pointer 601 connected with top-most vertices P. Deletion of duplicate data etc. is performed by such processing and the update process about the neighboring data 51 is completed.
[0065] Furthermore, the contrast scale value 511 on the strength in the data 51 of the side with other top-most vertices T connected with Zeros P and Q is L* a* b* of P and T after integration. It is updated based on the average and the number of configuration pixels (drawing 16 formula of the middle). This processing is the same as that of the thing in an update process of the top-most-vertices data 50 mentioned above. If the data of the side which should be updated on the occasion of renewal of the new contrast scale value 511 on the strength after integration are deleted from B-tree temporarily and the contrast scale value 511 on the strength is updated, a processor will register the pointer to data 51 into the B-tree 80 by using the new contrast scale value 511 on the strength as a key.
[0066] Processing of step S44 is completed by the above. Then, processing of steps S42-S44 is repeated, and processing is performed until return and the total number of clusters of image data 21 are set to "1" to step S42. And when the total number of clusters is set to "1", field integrated processing is ended. Consequently, image data 21 is unified by one top-most vertices (cluster) 250.
[0067] In addition, although the field integrated processing mentioned above makes one cluster carry out sequential integration of other clusters, it is also possible to perform field integration to juxtaposition in the part of image data. Such parallel processing especially sets and is as effective as an early integrated fault.
[0068] Termination of the field integrated processing by the procedure in which it was expressed with the flow chart of drawing 17 writes in and saves the node data 70 of a binary tree which express integrated hysteresis below at external storage. In addition, since the number of the node data 70 which constitute a binary tree becomes twice [about] the total number of pixels of image data, the number of data of a binary tree reaches a huge number. Therefore, in having performed all binary tree retrieval of the data of a binary tree, the burden spent on this retrieval is too heavy.
[0069] Then, in this advanced technology, it writes in external storage in order of binary tree retrieval of this, it reads from external storage every node data 70 by this and the reverse order at the time of read-out, and uses for retrieval every node data 70 which constitutes a binary tree. By doing in this way, it becomes possible to reduce the burden for binary tree relocation sharply.
[0070] The processing at the time of the writing from the root node to external storage and reading is explained based on drawing 20 .
[0071] The following processings are recursively performed by making a root node or a predetermined node into the

starting point at the time of writing. First, the label 701 in the node data 70 used as the starting point and L* a* b* Each averages 702-704 and the contrast scale value 705 on the strength are written in external storage. Next, with reference to the pointer 706 to this node data 70 sub tree, if the pointer 706 to a sub tree is not a blank, the following node data 70 which the sub tree 706 shows will be written in external storage. When a pointer 706 is a blank, after the node data 70 with which this pointer 706 was written in write the purport which is a "leaf" in external storage, processing with the same said of return and a pointer 707 is performed to the parent node on one. By repeating the above processing, it can write in external storage in order of binary tree retrieval of the node data 70.

[0072] In addition, in the above-mentioned write-in processing, although the pointer 706,707 to a sub tree is distinguishing the node data 70 used as the "leaf" of a binary tree by whether it is a blank, the contrast scale value 705 on the strength may carry out by whether it is a blank. Moreover, you may judge that the node data 70 concerned are a "leaf" with the measurement size 505 in the top-most-vertices data 50 corresponding to the node data 70 having been set to "1."

[0073] Then, reading processing of the node data 70 is explained. First, in an image processing system, the field of the node data 70 is secured on the work-piece memory of self used as a working area, and each data in the node data 70 used as the starting point read from external storage here is transmitted. Next, the node data read from work-piece memory secure the node data 70 new as a thing which the pointer 706 of this node data 70 points at, and read the data from work-piece memory there. If the read data are not a "leaf" at this time, the processing same about the pointer 706 of the node data 70 will be repeated. In being a "leaf", reservation of the node data 70 new as a thing pointed at by making the pointer 706,707 of this node data 70 into a blank by the node on one at the pointer 707 of return and its node and the data from work-piece memory are read, and it continues processing about the pointer 706 of this node data 70.

[0074] Then, processing of a field extract in which this binary tree was used is explained. As shown in (a) of drawing 15 , finally image data was unified by the field integrated processing mentioned above at one cluster (top-most vertices) 250. By following the process of this field integration conversely, as shown in (b) of drawing 15 , it is possible to obtain the image data 22 which divided image data 21. That is, the image data showing a background, a person, etc. will be divided into the image field of a background, a person's image field, etc., and a desired image field can be extracted.

[0075] That is, although the cluster of 1 can be divided into two clusters one by one by following the binary tree (historical data) toward "the leaf (leaf)" from the root node, the following procedures determine beforehand to which depth a binary tree is followed.

[0076] First, the minimum (the range of similarity) of a contrast scale value on the strength is beforehand set up as conditions which terminate division. That is, in the process in which one cluster is divided according to the binary tree, if the chromaticity of each cluster approximates to some extent, it will be for stopping division processing. By defining the minimum (the range of similarity) of this contrast scale value on the strength, and terminating division at this minimum, an image can be divided now for every field from which the description is completely different.

[0077] If the lower limit of a contrast scale value on the strength is defined, a size judgment of a contrast scale value on the strength will be made on the basis of this. That is, it judges whether it is smaller than the lower limit the contrast scale value 705 on the strength in the node data 70 of the root was instructed to be. At this time, when the contrast scale value 705 on the strength is smaller than a lower limit (similarity beyond a predetermined value), processing is ended.

[0078] On the other hand, when the contrast scale value 705 on the strength is larger than a lower limit (similarity below a predetermined value), processing is ended with reference to the pointer 706,707 in the node data 70 (namely, when a pointer 706,707 is a blank, and when a sub tree does not exist). When a pointer 706,707 is not a blank, the node data 70 of the sub tree shown with the pointer 706,707 are referred to. And processing is ended when the contrast scale value 705 of this sub tree on the strength is smaller than a lower limit.

[0079] A binary tree is limited by repeating these processings (the branch of a binary tree is cut on the way). And each cluster shown by the "leaf" of the binary tree limited by doing in this way is that from which the description was different to some extent.

[0080] Although the binary tree which makes a node 250 the root is prolonged toward each pixel of image data 21 as shown in (b) of drawing 15 , the binary tree which uses four clusters as a "leaf" is obtained by cutting this binary tree on the way.

[0081] Thus, the block-definition data in which the field divided considering each leaf of the limited binary tree as a root node of the sub tree not more than it is shown are generated. In addition, this block-definition data is 2-dimensional data with the coordinate value corresponding to image data 21. This block-definition data generation processing is performed as follows. First, the pointer 706,707 of a root node is referred to. And when a pointer 706,707

is a blank, x in a real image and a y-coordinate are computed from a label 701, and a label 701 is written in the coordinate of the block-definition data corresponding to this x and a y-coordinate. On the other hand, when a pointer 706,707 is not a blank, the same processing as the above is repeated with reference to the node data 70 of the sub tree shown with these pointers 706,707.

[0082] By performing such processing, a label 701 is given to each field to which the **** was divided. And it becomes possible to extract a desired field from image data 21 based on the label 701 given to each field. Therefore, it means being able to say that only the field showing a person is extracted from the image data showing an above-mentioned person and an above-mentioned background.

[0083] By performing an image processing with the advanced technology of such technique shows an example of the image by which field division was carried out to drawing 22 and drawing 23 . Drawing 22 expresses the subject-copy image. Drawing 23 R> 3 expresses the data which carried out field division of this subject-copy image. By performing hierarchical clustering about the subject-copy image of drawing 22 , as shown in (a) of drawing 23 , (b), and (c), the cluster is unified in order.

[0084] Drawing 24 is a tree showing the process which carries out field integration of the subject-copy image of drawing 22 . The axis of abscissa of this tree expresses whenever [dissimilar / of field integration] with a logarithm. Moreover, the image of each phase of the arrow head (A) given to drawing 2424 , (B), and (C) supports (a) of drawing 23 , (b), and (c), respectively.

[0085] Drawing 26 , drawing 27 , and drawing 28 are graphs which show the top-most vertices and the side in each phase of field integration, support (a) of drawing 23 , (b), and (c), respectively, and show the top-most vertices and the side in each phase of field integration, respectively. Drawing 26 is the graph of the phase of the arrow head (A) of drawing 24 , and drawing 27 is the graph of the phase of the arrow head (B) of drawing 24 . Furthermore, drawing 28 expresses the graph of the phase of the arrow head (C) of drawing 24 .

[0086] Drawing 25 shows the images 121a-121f in each phase which carries out field integration of the subject-copy image 121 (the same as that of what was shown in drawing 22). The images 121c, 121d, and 121e of this drawing support (a) of drawing 23 , (b), and (c).

[0087] In the above, the detail of the hierarchical field extract approach as advanced technology which this invention person proposed was explained. And in this advanced technology, hierarchical clustering is performed by unifying what serve as min of the contrast scale value on the strength on a color space among adjoining cluster pairs (it becomes the max of similarity). Therefore, since what is necessary is to make a judgment of field integration only about an adjoining cluster, while being able to shorten the processing time sharply, the memory space which processing takes is mitigable.

[0088] Moreover, L* a* b* Since the clusters used as the min of the distributed change on a color space are unified, the field division corresponding to the vision property referred to as catching global contrast relation is attained. For example, in fields, such as a photograph, an image, and printing, gradation may be subjectively classified like "a light, middle, and a shadow." L* a* b* which agreed in the vision property according to this advanced technology Since field division is performed using the color space, division of a subjective image like "a light, middle, and a shadow" is attained.

[0089]

[Problem(s) to be Solved by the Invention] any of the image-processing approach learned conventionally -- although -- **** which this invention person shows to Japanese Patent Application No. No. 340077 [five to] in order are unsuitable for applying to the processing which divides an image into each field of "a light, middle, and a shadow" and to solve this problem -- the hierarchical field extract approach was proposed. And in this advanced technology, the hierarchical-cluster-analysis method is used for an image processing.

[0090] Generally, the storage resource of a computer is needed for application in the image of a hierarchical-cluster-analysis method in large quantities in the processing, and unreal storage capacity is needed for it about the processing activation with the usual computer.

[0091] That is, after terminating activation of a hierarchical field extract at once to a full screen, even if it only manages adjoining field relation according to the graph structure, the storage resource of a considerable amount is needed.

[0092] Though about 4 contiguity is only managed, the combination of adjacency is set in the image whose every direction is a hxw pixel, and it is 2hw. - (w+h)

It becomes. This will be set to hwC2 =hw (hw-1) / 2 if the combination of all pixels is dealt with (when using a matrix whenever [dissimilar]), the max of a pixel pair which generates the former and must be managed is proportional to the total number of pixels clearly, and, as for the latter, the maximum number is proportional to the square of the total number of pixels. When it is going to realize using the graph structure, from per [200] cluster pair, the storage

capacity of 300Byte(s) is needed and the storage capacity near the 100MByte is still needed also in about 512*512 image.

[0093] If processing speed is thought as important when processing a vast quantity of data with a computer, Lycium chinense will be desirable to the primary storage (main memory) of a computer in data. And securing the memory of the above storage capacity as a primary storage has economically large constraint for preparing storage capacity like this as a primary storage from there being reality which says that the cost of a storage resource at present is expensive on the other hand, although it will not be an impossible figure at all if it catches with the view called implementability. Moreover, although it is also possible to use virtual memory instead of a primary storage, since it becomes a vast quantity of overheads and the processing time will increase rapidly, a problem is large [transfer of data with enternal memory] in respect of practicality.

[0094] Moreover, when managing only the pair of the pixel which will carry out contiguity according to the graph structure soon, since there is no information on whenever [dissimilar / of the pair of all pixels], the applicability of the approach (the combination-approach) of computing whenever [dissimilar] recursively is limited.

[0095] In the advanced technology mentioned above in order to solve this problem, in order to make it used in proportion to the total number of pixels of the image with which the initial complement of a computer storage resource processes, the graph structure was used. When what it is going to deal with with a computer with small storage capacity is considered by this even if it is this although it came to suit processing with a computer, it is inconvenient from the point of storage capacity or execution speed.

[0096] then, the place made into the purpose of this invention -- a hierarchical cluster analysis -- the game of the color on the screen of an image -- in extracting the hierarchical field structure which specializes mutually and is materialized with contrast relation of-like, it is in offering the image-processing approach whose processing is enabled also in a computer with a comparatively small storage resource.

[0097]

[Means for Solving the Problem] This invention is performed as follows in order to attain the above-mentioned purpose. Namely, the 1st field integrated down stream processing which divides the image of a processing object into a necessary unit the 1st, and carries out field integration of the beam image about that configuration pixel at this rate at a unit, While considering as the image for one screen which collects the image of each above-mentioned unit acquired by this 1st field integrated down stream processing, and makes these an initial cluster and performing field integration about the cluster of this image, it is characterized by consisting of the 2nd field integrated down stream processing which saves integrated hysteresis.

[0098] Moreover, the 1st field integrated down stream processing which divides the image of a processing object into a necessary unit the 2nd, and carries out field integration of the beam image about that configuration pixel at this rate at a unit, While considering as the image for one screen which collects the image of each above-mentioned unit acquired by this 1st field integrated down stream processing, and makes these an initial cluster and performing field integration about the cluster of this image It is characterized by consisting of the 2nd field integrated down stream processing which carries out information preservation that the hysteresis information on field integration should be managed by the binary tree.

[0099] Furthermore, the hysteresis of field integration is characterized by managing by the binary tree while it includes the information showing the sequence of field integration, and the similarity between the fields by which field integration was carried out, and the coordinate information on the cluster integrated.

[0100]

[Function] The image of a processing object is divided into a proper unit in this invention. A beam image at this rate in a unit Perform field integration in the 1st step which carries out field integration about the configuration cluster, and a configuration cluster is decreased. After field integration in this 1st step ends, while adjusting a cluster [finishing / this integrated processing], treating as an image for the one original screen and performing field integration in the 2nd step, the extract of the target field is enabled by holding integrated hysteresis.

[0101] It is field integration in the 1st step being equivalent to pretreatment for lessening the number of several pixel ball clusters, and performing field integration in the 2nd step by making into an initial cluster what was obtained in this phase. Since processing becomes possible in the small number of data in each phase, and processing is enough made possible in the computer by which the storage resource was restricted and the hysteresis of integration is saved with the color component information on each of that occasional cluster The image extract of the target field is enabled by following this hysteresis.

[0102] carry out using the degree train of dissimilarity -- carry out using the graph structure -- the extract of a hierarchical field which carries out differentiation enactment mutually by contrast on the screen of an image needs a

vast quantity of storage resources on processing by computer application by the hierarchical-cluster-analysis method. Then, the number of the pixel, cluster, and field dealt with at once for every field integrated processing can be limited by dividing or blocking the image of a processing object and performing field integrated processing, and it is made like, and was made for processing to become possible also in the small computer of a storage resource by this in this invention.

[0103]

[Example] Hereafter, the example of this invention is explained with reference to a drawing.

[0104] carry out using the degree train of dissimilarity -- carry out using the graph structure -- the extract of a hierarchical field which carries out differentiation enactment mutually by contrast on the screen of an image by the hierarchical-cluster-analysis method In order to improve the point which needs a vast quantity of storage resources on processing by computer application By dividing or blocking the image of a processing object in this invention, and performing field integrated processing He carries out for the ability limiting the number of the pixel, cluster, and field dealt with at once for every field integrated processing, and is trying for processing to become possible also in the small computer of a storage resource by this.

[0105] For example, suppose that a screen is divided into the block used as the unit of 32x32 (= 1024) pixel. A pair of combination of the pixel generated as a matrix whenever [dissimilar] 523776 pieces -- becoming -- a pixel pair -- the amount of data per one -- temporary -- 50Byte(s) (whenever [dissimilar], as compared with the graph structure, since it is easy, the way of a matrix DS) The storage capacity needed for constituting this matrix on a primary storage if the storage resource which per batch takes is small is about 25 MByte(s). It becomes and becomes the magnitude of the storage resource of a standard computer. Moreover, if a batch, i.e., the number of pixels, decreases when using a matrix whenever [dissimilar], the combination of a pixel pair will decrease in proportion to a square. When the graph structure is used on this condition, for the early number of a pixel pair, the initial complement of 1984 pieces and a storage resource is about 0.55 MByte(s). It becomes.

[0106] It is not made to complete, but a halt hold is carried out in the place where whenever [dissimilar], or the number of clusters reached suitable conditions, and field integration with each block saves such integrated hysteresis, and performs this processing to other the blocks of all. In the phase which this processing ended to all blocks, relation with other fields of other blocks of the field of the arbitration of a block of arbitration is investigated, about all images, again, a matrix is constituted whenever [graph structure or dissimilar], processing of hierarchical field integration is performed again, and field integration is completed.

[0107] A halt of field integration with each block is faced carrying out 2nd field integrated down stream processing which is the 2nd field integration, and it becomes the point to make it decrease to the number of fields which is extent which can construct a matrix whenever [graph structure or dissimilar] by the whole image, and distribution of whenever [dissimilar / of each cluster pair] serve as homogeneity as much as possible.

[0108] Moreover, although the example which divided the image in the unit of a square block explains in the example of this invention, if the partial part of the screen of an image is suited and a block is not cared about as a rectangle of arbitration, you may be an indeterminate form, and also when a block can realize a hierarchical field extract at once by one, it refuses beforehand that it is what has a status as a modification of this invention approach.

[0109] Hereafter, the detail of the example of this invention is explained. The block diagram of the image processing system which can perform the image-processing approach concerning this example is shown in drawing 1 . This image processing system uses a computer and is constituted by a control unit 9, a bus 10, CPU (processor)11, input I/F (interface)12, program memory 13, the work-piece memory 14, an image memory 15, output I/F (interface)16, external storage 17, GDC (graphic display controller)18, and display 19 grade.

[0110] A control unit 9 is a man machine interface for giving an actuation input to the system called the keyboard or the joy stick, mouse, etc., or giving a command, and is used for conditioning, the actuation referred to as following a binary tree.

[0111] CPU11 performs processing of field division of an image etc. according to the program memorized by program memory 13. Input I/F12 is an interface for inputting the image data used as a processing object into this image processing system. Image data expresses a natural image, for example, consists of data of the color of 512x512-pixel RGB (red and G are Green and B of R is blue) (or CMYK (for a Magenta and Y, yellow and K are [C / cyanogen and M] black) or CIE LAB).

[0112] Program memory 13 is for storing the program data showing the procedure of CPU11 mentioned above, and CPU11 performs the storing program of this program memory 13, and processes the purpose.

[0113] The work-piece memory 14 is for holding the data (tree data, list data, etc. which are mentioned later) which CPU11 computes with processing of field division temporarily. Moreover, an image memory 15 is for storing the

image data inputted from input I/F12.
[0114] Output I/F16 is a digital interface for outputting the image data by which field division was carried out to external instruments (printer etc.), and is large capacity storage which external storage 17 is constituted by a hard disk unit, the optical MAG disk unit, etc., and saves image data, the image data by which field division was carried out, tree data, list data, program data, etc.
[0115] GDC18 generates an indicative data based on image data, the image data after field division, etc., and a display 19 is for displaying the image based on this indicative data, and showing an operator.
[0116] The detail of the image-processing approach concerning this example is explained. In carrying out hierarchical clustering of the image in the example of this invention (that is,) For example, although what are extracting the configurational relation and structure of global contrast of distribution of the color on the screen in a natural image a hit and among adjoining cluster pairs with the min of the contrast scale value on the strength on a color space (it becomes the max of similarity) is unified one after another First, as the 1st step, hierarchical clustering here considers as two or more division images, and as shown in drawing 2 , the number of pixels which should be processed is lessened and it tends to treat it by dividing into the magnitude which is easy to process, about the image of one sheet which should be processed (S110). And hierarchical clustering is performed about each division image, respectively (S120).
[0117] And it is the phase which hierarchical clustering constituted about each division image, respectively, and next, these whole division image that hierarchical clustering accomplished is collected as the 2nd-step processing, and it treats as an image of one sheet, that is, uses as an initial cluster, and hierarchical clustering of this is carried out (S130, S140). The hysteresis of integration is saved with the color component information on the occasional cluster in that case. And it enables it to divide the field part of a request of an image by following the hysteresis of integration, getting to know the cluster which presents the information on a desired color component, and extracting this.
[0118] By collecting a division image [finishing / clustering] in the whole image of one sheet, considering as an initial cluster, and adopting the technique referred to as clustering this again, after subdividing and clustering the image of one sheet Even when the amount of data which must be processed at once is lessened sharply and equipments, such as a personal computer without a memory resource, are used for the degree which has too much as an image processing system, it enables it to divide the image domain of the purpose in an image.
[0119] By this invention, although it is in charge of a hierarchical field extract and the hierarchical field extraction method using a matrix etc. can be used the hierarchical field extraction method using the graph structure, and whenever [dissimilar], since the hierarchical field extraction method using the graph structure was already described, this invention is explained to an example for the hierarchical field extract which uses a matrix whenever [dissimilar] here. In addition, although the natural image and the color space are arbitrary, the image of CLELAB color specification shall be used for the image data of a processing-object image here.
[0120] In this invention, CPU11 is divided into the size which is easy to process an image as shown in drawing 2 in the 1st-step field integrated processing to the inputted processing-object image according to the conditions later mentioned according to the block-size setting information which the operator set up by the control unit 9 (S110). The example which divided the image F of one sheet into Block B with the rectangle of fixed size, and carried out division imaging is shown in drawing 5 . In this example, size of the rectangle of each block (each division image) B is made into 32x32 pixels. Therefore, the total number of pixels of each block (each division image) B becomes 1024 pixels, respectively.
[0121] Drawing 6 shows the detail of each block (each division image) B. Moreover, drawing 4 is the outline of the processing flow of this invention. The index of a matrix is shown whenever [column, relative-coordinate / of Rhine /, and dissimilar-within block].
[0122] Moreover, when it divides into block sizes [image / of one sheet], the rectangle with which the size is not filled may arise. In this case, you may make it process, as soon as it will center the location of a block group suitably, if the border section of an image does not become a problem noting that it is also possible for the block (division image) used as **** to be disregarded and it is the odd block with which the above-mentioned block size is not filled about the block (division image) located in ****** of one screen. Moreover, if it is this case, how the total number of pixels of each block of every direction each side does not exceed 1024, such as carrying out a division-into-equal-parts rate like, and arranging the size of all blocks, can be considered.
[0123] Although the image-processing approach concerning the example of this invention makes hierarchical field integration the technique realized in two steps as a whole, if blocking of the image of one screen is completed, provisional field integration in each block (each division image) unit will be performed as the 1st-step field integrated processing (S120 of drawing 2).
[0124] If processing of provisional field integration initializes an integrated list (S121a), and carrying out in step S20 judges whether integrated processing of a whole block was completed (S121b), consequently it has not ended it first

probably as shown in drawing 3 (a), field integrated processing of the cluster is carried out about Block i (S122, S123). If field integrated processing of the cluster is ended about Block i, i will be updated (the following block) and it will confirm whether to be whether integrated processing has a non-ended block and no (S121b). Consequently, if integrated processing has a non-ended block, field integrated processing of the cluster will be carried out about the updated block i (S22, S123). And S121b is checked (S121b). Consequently, integrated processing will be finished if the block whose integrated processing is not ended is lost.

[0125] The detail of field integrated processing of the cluster about the block i carried out in step S123 is shown in drawing 3 (b).

[0126] Field integrated processing enables it to treat an index as a swing, and 1-pixel one cluster for every pixel first (S123-1). Next, a matrix is generated whenever [initial dissimilar] and it asks for dij (x y) and d (l* a* b*) whenever [dissimilar] between each pixel (between clusters) (S123-2). Next, the number of interblock fields is dij (x y) <1 and 21/2, if it has not come to investigate whether it was set to ki (S123-3). d (l* a* b*) detects the minimum pixel pair (cluster pair), and performs integrated processing (S123-4).

[0127] And a matrix is updated whenever [dissimilar] (S123-5), and if it next has not come to investigate whether the number of interblock fields was set to ki (S123-3), the processing after S123-4 is repeated. Step S As a result of the judgment of 123-3, if the number of interblock fields is set to ki, all field integrated hysteresis will be registered into a list (S123-6).

[0128] The above is provisional field integrated processing in each block (each division image) unit. Here, by the whole image for one screen, it shall unify to 1024 fields by performing the provisional field integration concerned. If unified by 1024 fields by the whole image for one screen, CPU11 will start the 2nd-step field integrated processing.

[0129] The 2nd-step field integrated processing uses 1024 fields obtained by field integrated processing in this 1st step as an initial cluster, adjusts the 1024 fields concerned, is used as the image for the one original screen, and carries out hierarchical integration by making these 1024 fields into an initial cluster.

[0130] In this invention, it makes it possible to process by the image-processing system of few memory resources by being made to perform processing in each phase about such 1024 data. However, this is an example as an example and, of course, is not limited to 1024 as the number of data to treat.

[0131] Allotment of the number of the last field integration of each block here in the 1st step (the number of the fields which finally remain with the block) Be [easy although / it] the number of pixels of one screen is divided by this total block count 1024 and it distributes to homogeneity simply, in consideration of the complexity of the image of one screen, each block evaluates the complexity of the pattern according to each location, and can consider how to distribute to the number of the last field integration according to it provisionally etc. For example, it asks for distribution of each block, distribution of each block is broken by total of the distribution for these the blocks of every, and that value is used as a ratio of allocation of provisional field integration of that block to 1024 in this case. And although the number obtained by this is used as the number of provisional field integration of each block, how to reround off for a suitable integer etc. is considered. Also at the lowest at this time, the number of the last field integration assigned to a block shall be "1."

[0132] Here, if whenever [dissimilar] is arranged, it will also be considered that it is made to carry out until it detects the cluster pair which has whenever [minimum dissimilar / in each block], it unifies from what has whenever [dissimilar / of the min of these pairs] and total of the number of fields within each block amounts to 1024 in this case. However, this has high possibility that count effectiveness will get very bad fundamentally. Then, when hierarchical field integration is performed, the field of each block is totaled at the last and it is over 1024 until it sets up whenever [dissimilar / which serves as a target provisionally] and the cluster pair more than whenever [this dissimilar] appears for every block in order to avoid this, again, whenever [target dissimilar] is set up more highly and how to perform until the total number of clusters in an image stops exceeding 1024 at the last can be considered.

[0133] Here, the 1st-step [above-mentioned] field integration shall be realized as a complicated scale **** thing of the hierarchical field as for which distribution of each block carries out differentiation formation by contrast of the color of the image on a screen.

[0134] If the image data for one screen is inputted through input I/F12, CPU (processor)11 of an image processing system will perform the 1st-step field integrated processing which incorporates this to an image memory 15, and was mentioned above about this incorporated image data. Although natural processing is performed for starting this 1st-step field integrated processing, this pretreatment is block division of the above-mentioned image data (S110). And if divided into a block, the 1st-step field integrated processing will be started next (S120).

[0135] [the 1st-step field integrated processing] -- after field integrated processing of one block has finished processing (processing by S120) here for the field processing in each block one by one fundamentally, the loop formation of

moving to field integrated processing of another following block is made. In the field processing in each block, as first shown in drawing 6 , it carries out an index or with a label to each pixel. Since it corresponded to the component of a matrix whenever [dissimilar] about the index, about sequential assignment and label attachment, the coordinate value of a relative raster was used for the continuous integer which begins from "1" here.

[0136] A label is a meaning within a block, and also it shall be defined from the coordinate value of each pixel to the whole image here so that the whole image may also be a meaning. For example, if a label 190 is data which are 32 bits as shown in drawing 6 , the technique referred to as setting the coordinate value of Rhine to 16 bits of the high order, and setting the coordinate value of a column to 16 bits of low order is taken.

[0137] (Whenever [dissimilar] matrix generation) After finishing the index or with a label, CPU11 generates a matrix whenever [dissimilar] next. [within a block] [to each pixel]

[0138] The matrix was made into the two-dimensional array 120 as shown in drawing 7 whenever [dissimilar]. And it is determined that the value of the component 121 of an array corresponds to the pair of the coordinate value (index) of the cluster in the above-mentioned block. Each array component is a pointer to the structure 130 which has the information on a pixel pair (cluster pair). This information-structure object 130 consists of [whenever / pointer information section / to the status information structure of Cluster P / 131, pointer information section / to the status information structure of Cluster Q / 132, P / on a color space /, and dissimilar / of Q] information bureaus 134 whenever [P / on an information bureau 133 and a screen /, and dissimilar / of Q], as shown in drawing 8 (a).

[0139] It is [whenever / dissimilar] in charge of matrix generation, and it treats noting that it is 1-pixel one cluster in the 1st-step field integrated processing as initial condition of a field integrated course. And the member of the structure 130 consists of an information bureau 131,132 for making the pointer information to the structure 140 which shows the condition of the cluster of each cluster which makes a pair hold, and an information bureau 133,134 for making the information on whenever [dissimilar / in this cluster pair] hold in this case.

[0140] Moreover, the information on whenever [dissimilar] makes whenever [dissimilar / about the distance on a screen] hold to an information bureau 134, and makes whenever [dissimilar / about color space distribution] hold to an information bureau 133. Information shows whenever [dissimilar / about the distance on the screen between clusters], and information shows [whenever / dissimilar / which is stored in an information bureau 134 whenever / dissimilar / about the distance on the above-mentioned screen] whenever [dissimilar / about the likeness nature of a color class between clusters] whenever [dissimilar / which is stored in an information bureau 133 whenever / dissimilar / about color space distribution].

[0141] As whenever [dissimilar / about the distance on a screen], the scale of adjacency shall be expressed and it shall be set as a minimum distance method in this case here. moreover -- although whenever [dissimilar / about color space distribution] turns into a scale of the likeness nature of a color class -- here -- Ward (WORD) -- it shall be given by law

[0142] Moreover, as shown in drawing 8 (b), the structure 140 holding the information on the condition of each cluster In the case of the label information bureau 141 which stored the label of that cluster, the information bureau 142 which stored the measurement size (several n pixel), and this example, further Each color component L*, a*, and b* It consists of an information bureau 143,144,145 which stored average information, and an information bureau 146 which stored the pointer information to integrated hysteresis, and such information is held.

[0143] In generation of a matrix, matrix generation is performed [whenever / dissimilar / whenever / early dissimilar] in generation step S123-2 of a matrix whenever [dissimilar / of the first stage shown in drawing 3 (b)]. It makes by writing each pixel and the information on a pixel pair in the structure 140 about the condition of a cluster, and the structure 130 about a cluster pair in generation step S123-2 of a matrix, and writing the pointer to this in the matrix component 121 in drawing 7 whenever [this early dissimilar]. That is, the pointer to the binary tree 150 which consists only of the value of the color component of each pixel, a value called "1" as the number, and a root node is written in the structure 140 about the condition of a cluster.

[0144] Next, CPU11 registers the required initial information about all pixel pairs into the structure 130 holding the information on a cluster pair. There is [whenever / pointer / to the data of each pixel which serves as the pair about all pixel pairs / 131, and dissimilar / on a color space] an information bureau 134 in the structure 130 whenever [dissimilar / on an information bureau 133 and a screen]. The pointer value used as the mark to the data of each pixel which serves as the pair about all pixel pairs is registered into the pointer 131 in the structure 130. Information is registered [whenever / dissimilar / on a color space] into an information bureau 133 whenever [dissimilar / of a color component], and whenever [dissimilar / of the minimum distance method as a distance on a screen] is registered into an information bureau 134 whenever [dissimilar / on a screen]. As whenever [dissimilar / of the minimum distance method as a distance on a screen], Euclidean distance is found and it is used, for example.

[0145] Thus, a matrix is completed whenever [dissimilar / in early stages of field integration]. If a matrix is completed whenever [dissimilar], CPU11 will start the hierarchical field integrated processing within a block next (step S 123-4).

[0146] Step S First, whenever [dissimilar], with reference to a matrix, adjacency has the hierarchical field integrated processing within the block in 123-4, and, moreover, it carries out cluster integration one by one from the high cluster pair of the likeness nature of a color class.
[0147] this "adjacency -- it is -- specification of high cluster pair" of the likeness nature of a color class -- whenever [for example, / according that it is this case to minimum distance method dissimilar] -- below a predetermined value -- it is -- Ward -- whenever [dissimilar / by law] -- the minimum thing -- with, it decides. If "1" is taken as said predetermined value here, adjacency will become about 4 contiguity and will serve as below the "root 2 (= 21/2)", then about 8 contiguity as a predetermined value.
[0148] If the cluster of the relation from which whenever [that dissimilar] becomes the minimum thing about a certain cluster and the cluster of the about 4 contiguity or about 8 contiguity in that cluster, i.e., a cluster pair, is specified, CPU11 will make the pair of these two clusters the information on one cluster first next. That is, the new cluster status information structure 140 is generated.
[0149] The cluster status information structure 140 consists of the label 141 pixel information bureau [several n] information bureau 142, the muL* information bureau 143, the mua* information bureau 144, a mub* information bureau 145, and the pointer information section 146 to the binary tree root node of field integrated hysteresis, as shown in drawing 8 (b), and it performs generation of data as follows.
[0150] With, it considers as label information. first, either of the labels of two clusters integrated about a label -- Store this in the label information bureau 141, and this is made into several n pixel information in quest of the sum of the number of pixels of the two above-mentioned clusters about several n pixel information. This is stored in the several n pixel information bureau 142, and each average of each component of the color after integration is recalculated, and it is this Each color component L*, a*, and b* It stores in the information bureau 143,144,145 for average information storing. This obtains the cluster status information structure 140 which wrote in the data after field integration of some two clusters integrated.
[0151] Moreover, the structure 150 of a binary tree node with the new **** structure shown in (a) of drawing 9 is generated and recorded on the pointer information section 146 to the root node of the binary tree of field integrated hysteresis. That is, the structure 150 of a binary tree node consists of the pointer information section 151 to the node of Branch P, the pointer information section 152 to the node of Branch R, and the pointer information section 153 to integrated status information, and registers the pointer to the integrated hysteresis of the cluster integrated into the pointer information section 151 to the node of the branch P in the structure 150 of the binary tree node generated now, and the pointer information section 152 to the node of Branch R. And that pointer information is recorded on the pointer information section 146 of the information-structure object 140 of a cluster condition as a root node of integration according this newly generated binary tree to this.
[0152] Moreover, the structure 160 of integrated status information is obtained as data of this new root node 150. As shown in (b) of drawing 9 , the structure 160 of integrated status information It consists [whenever / dissimilar / on the label information bureau 161, the several n pixel information bureau 162 after integration, the muL* information bureau 163, the mua* information bureau 164, the mub* information bureau 165, and a color space] of each part of an information bureau 167 whenever [dissimilar / on an information bureau 166 and a screen]. The label information after integration to the several n pixel information bureau 162 after unifying the several n pixel after integration to the label information bureau 161 To the muL* information bureau 163, the average of a* color component after integration for the average of L* color component after integration to the mua* information bureau 164 Whenever [dissimilar / on the color space at the time of integration] is recorded on the mub* information bureau 165, whenever [dissimilar / on the screen at an information bureau 166 and the time of integration] is recorded [whenever / dissimilar / on a color space] for the average of a* color component after integration on an information bureau 167 whenever [dissimilar / on a screen], and the pointer to this is recorded on 153.
[0153] In addition, the condition of a binary tree node at the time of an initial state, i.e., 1-pixel one cluster, is shown in drawing 10 .
[0154] In drawing 10 , the pointer information section 151 to the node of the branch P in the structure 150 of a binary tree node and the pointer information section 152 to the node of Branch R are null pointers as shown in drawing 11 , and they are ******(ed) without the branch beyond this. Moreover, the integrated status information 160 which the structure 150 of this binary tree node points at shows the condition of that pixel. As shown in drawing 11 , the label information bureau 161 namely, the value of the label of the pixel Moreover, although the color component value of the

pixel is stored in the several n pixel information bureau 162 after the integration in which "1" stores the average of a color component as the number of pixels in the several n pixel information bureau 162 which is a measurement size again, the muL* information bureau 163, the mua* information bureau 164, and the mub* information bureau 165, respectively An information bureau 166,167 is information un-setting up whenever [two dissimilar / at this time].
[0155] Since these integrated hysteresis is arranged under a new root node whenever it carries out field integration, this initial state will be in the condition of a leaf in an integrated hysteresis binary tree. As a result of carrying out field integration one after another, the integrated hysteresis binary tree obtained is shown in drawing 12 . This integrated hysteresis binary tree is registered into a list (S137), and it enables it to reproduce the hysteresis of integration by following this list afterwards. In addition, the list node structure 170 of the integrated hysteresis binary tree shown in drawing 13 at drawing 12 is shown.
[0156] The list node structure 170 consists of the pointer information section 171 to degree node which stores the pointer information to degree node, the pointer information section 172 to the front node which stores the pointer information to a front node, and the pointer information section 173 to the data which store the pointer information to data.
[0157] By the above, the processing about field integration of the configuration pixel (cluster) in each block is completed. Since the cluster status information structure 40 to the cluster integrated becomes unnecessary, it cancels here.
[0158] As mentioned above, the integrated processing carried out in step S123-4 is repeating processing of the loop formation of step S123-3 to S123-5, and is unified to the smallest cluster pair of whenever [dissimilar / which sometimes comes out]. And at this time, although integration is terminated in the phase in which the number of fields (the number of clusters) became the predetermined value ki, integrated processing is repeated until the number of fields (the number of clusters) becomes the predetermined value ki, updating a matrix whenever [dissimilar].
[0159] Therefore, the update process of a matrix is described here whenever [dissimilar / which was performed in step S123-5]. The update process of a matrix is performed as follows by the minimum distance method whenever [dissimilar]. When setting whenever [dissimilar / between Clusters i and j] to dij, setting to p and q two clusters before the integration which d Becomes whenever [dissimilar], setting these which are integrated and the cluster which makes a pair to r, and using as t the cluster which unified p and q and was generated, with a minimum distance method, it is dtr=min (dpr, dqr).
a next door and Ward -- law -- dtr= It is computed by {(np+nr) /(np+nq+nr)} dpr+{(nq+nr)/(np+nq+nr)} dqr-{nr/(np+nq+nr)} dpq and the recursive target.
[0160] It is carrying-out [deleted from the matrix the cluster information which makes either p or q and a pair whenever / dissimilar / here, substituted the null pointer as a matrix component, and / registration deletion] ****. the cluster pair information-structure object 130 which corresponds the information in the cluster pair to them about a pair of cluster which adjoins the clusters p or q left behind to the next -- whenever [dissimilar] is updated about all (P on a color space, P on an information bureau 133 and a screen, renewal [Whenever / dissimilar / of Q / whenever / dissimilar / of Q] of contents of an information bureau 134).
[0161] At the end, the information about the pair of two clusters integrated is deleted from a matrix whenever [dissimilar], and the 1st-step field integrated processing in a block unit is completed.
[0162] This processing is repeated until it reaches the provisional number of fields (the number of clusters) defined previously about each of each block. And when the previous provisional number of fields is reached by performing field integrated processing, the integrated hysteresis which each cluster has is saved (when field integration accomplishes to the number of fields). As for this, carrying out a stack (integrated hysteresis list) etc. saves by carrying out the pointer to the root node of for example, each integrated hysteresis. Moreover, if there is need, a matrix will be degenerated whenever [dissimilar] in the size of the cluster which remains, and a matrix will be kept whenever [this dissimilar].
[0163] Thus, field integration provisional about each of all blocks is performed, and the integrated hysteresis is kept (S123-6 of drawing 3 (b)). Above, the 1st-step field integrated processing finishes.
[0164] [the 2nd-step field integrated processing] -- after the 1st-step field integrated processing finishes, the 2nd-step field integrated processing is started next.
[0165] The 2nd-step field integrated processing is processing which performs field integration about the whole image which adjusted and obtained each [these] primary stage cluster, using the field obtained by hierarchical field integration for every block which is the 1st-step field integrated processing as an initial cluster (processing of drawing 2 of S130 and S140). In this phase, the hysteresis of field integration is saved with the color component information on that occasional cluster. And it enables it to divide the field part of a request of an image by following the hysteresis of

integration, getting to know the cluster which presents the information on a desired color component, and extracting this.

[0166] In this 2nd-step field integrated processing, processing of step S130 is first performed as pretreatment, and a matrix is generated whenever [dissimilar / which becomes it of the whole image about degradation of the field integration for every block]. That is, a matrix is generated whenever [dissimilar / by the relation of the field of arbitration and the field of the arbitration of a block of other arbitration in the block of arbitration].

[0167] If it degenerates and the matrix is kept whenever [dissimilar] by the processing for every block in the 1st-step field integrated processing, the relation between the fields within a block will be held. However, only in the case of integrated hysteresis, since the relation between fields is not held, a matrix must be reconfigurated whenever [dissimilar] once again in this case here.

[0168] When reconfigurating a matrix whenever [dissimilar] here, it is a scale for adjacency, and whenever [dissimilar / by the minimum distance method] needs to ask for whenever [dissimilar] about no fields (pair of a cluster) in this phase, if adjacency is limited to about 4 (four which touches on all sides), and about 8 (four which touches on all sides, and four total 8 which touches a diagonal location). Hereafter, an example which reconfigurates a matrix whenever [dissimilar] is explained with reference to the flow chart of drawing 4 only from integrated hysteresis.

[0169] In order to reconfigurate a matrix whenever [dissimilar], label image generation processing is performed first (S131). First, this prepares the image of a processing object, and the storage region of the same size for the work-piece memory 14 as an object for label images, and begins them from writing in a label image as follows and generating it to this.

[0170] Namely, if a label image follows a binary tree from the root node of each integrated hysteresis and arrives at the location of a leaf (leaf) with reference to the integrated hysteresis currently kept (in this case, it refers to as a list) From the information on the field in early stages of integration which the leaf points out (namely, information on a pixel), while computing Rhine (line) of read-out and its pixel, or the coordinate value of a column (train), a label It carries out by writing the value of the label of the root node of the integrated hysteresis in the place corresponding to the coordinate value of the storage region for the label images on the work-piece memory 14 secured previously.

[0171] If such processing is performed about the binary tree of all integrated hysteresis, a label image will be obtained, and if there is this label image, the situation of the screen separation of the field integrated result in said 1st step will be in the condition that the value of the label of that field can refer.

[0172] If a label image is generated, a matrix will be generated whenever [initial dissimilar] next (S132). And a profile trace is performed on the above-mentioned label image about each field using this (S135). The field which faced it and touched in the phase of this profile trace is a field contiguous to this field, and limitation of the adjacency of a field can be filled by whether about eight it carries out by whether the method of a profile trace is carried out about four.

[0173] What realized this is shown in drawing 14 . Drawing 14 R> 4 shows the situation of field integration of Blocks I and II. 1 point A1 in a field is obtained from the label obtained from the integrated hysteresis of Field A. It shifts to the left from this coordinate, and block boundary A3 is reached. The boundary of the last of Field A and other fields is A2, and starts a profile trace for this from this as one on the boundary of the outside of Field A. It turns out that the fields which touch Field A by this trace are b, d, e, a, and c. If it sees about the field e adjacent to a block boundary, the field adjacent to Field e will be set to b, i, k, l, m, g, n, a, and A. Thus, a profile trace can be performed on a label image.

[0174] It explains concretely. First, a matrix is generated [whenever / initial dissimilar] as a matrix whenever [dissimilar / in data the condition of not registering] (S132), and then a stack (integrated hysteresis list) is referred to as a list once again (S134). The label of the root node of each field integrated hysteresis becomes one in the field. From this point on a label image, it moves to either the right or the left a top and the bottom, and the boundary of the outside of a field is determined. This is because the field may have become anchor ring-like. Moreover, distinction of being the boundary of the outside of a field is migration on the label image of this point, and presupposes that it is the point of having moved to other fields from this field at the last by the time it arrived at the boundary of the block with which that field belongs.

[0175] Whether it is the field concerned can identify by whether it is in agreement with the thing of the field concerned with reference to the value (label value) of the image of a label image which sometimes comes out. If this point becomes settled, a profile trace will be started with this point as the starting point (S135).

[0176] A profile trace can be performed if conditions that the point outside the field concerned is in the right or left of a trace point are followed. And this trace is ended in the place whose trace point corresponded with the trace start point, and it moves to processing by the following integrated hysteresis.

[0177] Let this be a field adjacent to the field concerned with reference to the label value of the pixel of the field which touches the field concerned in the case of this profile trace (it is in a field and an opposite direction concerned to a moving point). What is necessary is to perform the writing of a matrix whenever [dissimilar], only when memorizing the value of the label of the adjoining field referred to immediately before at the time of migration and the label value of the present adjoining field and it change.
[0178] The index of a matrix costs whenever [dissimilar] for the sequence of registration of integrated hysteresis.
[0179] When a new adjoining field is found here, the root node which has the same label as an adjoining field from the list of integrated hysteresis is detected. And the information-structure object of a cluster pair is generated about a field and this adjoining field concerned, and the pointer to this cluster pair information-structure object is registered into the index location of a matrix whenever [this two dissimilar / of a field] (step S136 of drawing 4). Moreover, whenever [dissimilar / in the Ward method] is computed from the cluster information-structure object of the root node of the integrated hysteresis of two fields. moreover, a distance actual as a degree of non-** by the minimum distance method at this time -- not but (if it adjoins, whenever [dissimilar] will become "1" or "the root 2 (2 square roots)") -- ****** -- here, "0" which means only adjoining is set.
[0180] Furthermore, the value of the pointer to the structure of the cluster information on the root node of integrated hysteresis is set to the column of the pointer to the cluster status information structure which the information-structure object of this cluster pair shows, respectively.
[0181] The already registered adjacency may be detected after the second field. Moreover, it may also happen to adjoin the field which contiguity finished once by the time the profile trace was completed also in the one-eyed field 2 times or more. In this case, only when the index of the two fields of whenever [dissimilar] concerned refers to, and seeing whether it is registered and having not registered, it is made to perform registration processing (S136).
[0182] If the adjoining field according to a profile trace as mentioned above is detected about all the hysteresis of the list of field integrated hysteresis and it is completed (S133), the pair of a non-registered index will be detected by hitting the index one by one in a matrix whenever [dissimilar] (S137).
[0183] If the pair of a non-registered index is detected in processing of step S137, based on an index, an integrated hysteresis list will be searched, and a cluster pair information-structure object will be generated and registered in the same way as the time of an adjoining field. At this time, the degree of non-** in the Ward method is similarly computed with having carried out between adjoining fields. Whenever [dissimilar / of a minimum distance method] is set to "1" in order to show saying that it does not adjoin. Moreover, the reference to the status information of each cluster which makes these cluster pair becomes being the same as that of having been between adjoining fields.
[0184] By the above actuation depended on CPU11, a matrix is completed whenever [dissimilar / for using for the 2nd-step field integrated processing]. Moreover, since a label image becomes unnecessary at this time, it eliminates from on the work-piece memory 14.
[0185] Processing of step S130 finishes above and then processing of step S140 is started. Processing of step S140 is field integration. Although the hierarchical field integration in the field integrated processing performed here is completely fundamentally the same as it of the 1st phase, it carries out until a field is finally unified by one field, and makes field integration complete in field integrated processing in this 2nd step.
[0186] Like [field integrated processing in this 2nd step] field integrated processing in the 1st step, too, CPU11 continues generating integrated hysteresis and considers this as a final output. And CPU11 saves the generated integrated hysteresis concerned at external storage 17.
[0187] Although it is the same as that of what was previously explained with the advanced technology about the handling of the binary tree of integrated hysteresis, in hierarchy low order, it is necessary to understand the point, since the field adapted to a block configuration may be detected, and to treat integrated hysteresis.
[0188] Although the above example described the hierarchical field integration by the matrix whenever [dissimilar], even if it uses the graph structure instead of a matrix whenever [dissimilar], the same processing result is obtained.
[0189] Moreover, this invention approach does not need to divide into a block for the whole pixel of one screen, and not necessarily uses a certain pretreatment, for example, a sampling pitch, or an image with coarse resolution (rough image). Once, since hierarchical field integration is carried out, determine the parts of an extract object domain, a background, and others, record this boundary part, and it limits to this part of the small image of a sampling pitch with shortly high or resolution (full image). By applying this approach, the technique referred to as realizing a field extract is employable.
[0190] When projecting the boundary of a rough image on the full image, naturally, the boundary line became intermittent or carried out polygon approximation. However, if surround and die so that it may be made the anchor ring which gave the suitable width of face for this or this polygon may be included with a rectangle block, and these are

treated as a block, hierarchical field integration by this invention is performed and integrated hysteresis is acquired, it will become possible to carry out the profile extract in a full image using this acquired integrated hysteresis.
[0191] The example of this invention is adjusted. After the fundamental view of this invention carries out field integrated processing in the 1st step to the given image and lessens the number of clusters, it is in the point of carrying out field integrated processing in the 2nd step by making this into an initial cluster. Although there is adjacency and field integration is preferentially carried out from the cluster of dissimilar [on a color space] whenever min in that case, hysteresis management at this time is carried out. How to manage by the binary tree is adopted as this hysteresis management.
[0192] The point that this inventions to the advanced technology differ divides an image into the block of magnitude which can sufficiently respond to a suitable calculating-machine storage resource first as the 1st-step field integrated processing. Within this block By performing a certain amount of hierarchical field integration, it is the point of decreasing the number of these integrated field to extent in which a hierarchical cluster analysis is possible, performing these fields as the 2nd-step field integrated processing, performing field integration as an initial cluster again next, and having made it make field integration completing.
[0193] that is, carry out using the degree train of dissimilarity -- carry out using the graph structure -- the extract of a hierarchical field which carries out differentiation enactment mutually by contrast on the screen of an image needs a lot of storage resources on a computer by the hierarchical-cluster-analysis method. So, in this invention, the number of these integrated field is decreased to extent in which a hierarchical cluster analysis is possible by dividing an image into the block of magnitude which can sufficiently respond to a suitable calculating-machine storage resource, and performing a certain amount of hierarchical field integration within this block first, as the 1st-step field integrated processing. And also in the 2nd-step field integrated processing, the original image can deal with it now in the magnitude which can sufficiently respond to the suitable above-mentioned computer storage resource by field integration having been carried out by the 1st-step integrated processing in each above-mentioned block, and the number of data (the number of fields) having decreased, and adjusting each [these] block, treating as one screen, and being made to perform the 2nd-step field integrated processing.
[0194] Field integration is performed and field integration is made to complete again in the 2nd-step field integrated processing by making the field after the above-mentioned field integration into an initial cluster.
[0195] As long as the problem on precision etc. has the need with a natural thing, you may make it increase two steps of this field integrated processing with three more steps and four steps. moreover -- as the method of a setup the block in the time of the first stage -- most -- simple -- Rhine Callum each suitable direction -- there is the approach of dividing into a rectangle by suitable offset, and this is applied. Moreover, if there is need, it is not necessary to necessarily make size of these rectangles regularity. Moreover, a configuration may not be restricted to a rectangle, either and may be an indeterminate form.
[0196] And when it considers as an indeterminate form, the indeterminate form block is only one and does not care about hierarchization integration as for one step.
[0197] When the adjacency of a field tends to be managed by the matrix or the graph structure whenever [dissimilar] and it is going to generate the structure of the adjacency of a field, if the attribute (mainly coordinate value) of the pixel which constitutes a block is known, it is enough, and it is easy to ask for the pixel pair of arbitration or the pair of a contiguity pixel. in addition, the adjacency between the fields which were mentioned above and "which manage adjacency in procession whenever [dissimilar] and realize hierarchical integration of a field" -- the minimum distance method (or -- in addition) on a screen -- it is -- the likeness nature of a color class between fields, or the degree of contrast -- Ward -- while asking by law (or -- in addition) and managing these in procession whenever [dissimilar], it is carrying out field integration of the thing of dissimilar whenever min.
[0198] And it is the point referred to as that the merit of using a matrix whenever [dissimilar] can apply all the various combination-approaches. When performing hierarchical field integration using a matrix whenever [dissimilar], on the following condition screens, whenever [dissimilar / as the minimum distance] is below a predetermined value, and it is possible that it shall be chosen suitably out of the cluster pair which fulfills to coincidence two conditions which say that the likeness nature of a color class on a color space is below a predetermined value or the minimum value in a Ward scale.
[0199] In the example, the run unit of whenever [dissimilar], or a hierarchical field extract shall classify the image of one sheet into a block, and shall perform a hierarchical field extract in two steps. In this case, as the 1st step, block division is performed, and to each block, integrated hysteresis is created to these and it goes to them first. Fundamentally, as for field integration, each block suspends and suspends field integration by a certain amount of integration. The technique of the hierarchical field extract by the graph of a hierarchical field extract is the same as that

of the advanced technology, and, in the hierarchical field extract by the matrix, it performs by above-mentioned technique whenever [dissimilar]. Moreover, as it records by the binary tree like the advanced technology and management which enables the field extract of the request which caught synthetically each element, such as lightness of an image, a hue, saturation, and a coordinate, by following a binary tree can be performed, it enables it to divide an image into each field of "a light, middle, and a shadow" in this phase about generation of integrated hysteresis.

[0200] Field integration in the 1st step is not performed until integration within each block is completed, but it is stopped and suspended in the place where predetermined conditions were fulfilled, and continues processing of other blocks similarly. When processing of this phase is completed about all blocks, the relation of the cluster of each block is arranged and reunified about the whole image.

[0201] With the conditions of a halt and hold of field integration in the 1st step of each block The formation conditions of contrast and these relation of all the clusters when seeing as the whole image fall within a range about 1 law fundamentally, and the number of it, simultaneously the cluster in the whole is a matrix whenever [dissimilar]. Or it shall be the number manageable [with a graph], i.e., the condition to which data were settled in the storage resource capacity of a calculating machine.

[0202] As what is considered as this condition precedent, it is (a). It is (b), when the cluster within a block becomes fixed numbers or it becomes less than [it]. It is a time of reaching, more than [having been fixed] there is whenever [dissimilar / on the color space of each cluster within a block] etc. however, the time of not reaching this condition but a block being unified by one cluster -- this -- with, it considers as a halt.

[0203] The number reduction of clusters of every one field is performed until it will already perform one field integration from the small block of a contrast condition most and the total number of clusters will become a predetermined value in the phase which the 1st-step field integrated processing of each block ended, if it is more than constant value with the total number of clusters.

[0204] the number of permission clusters of each block from the statistical parameter of each block, for example, a variance etc., -- setting -- the 1st-step field integration -- the number of this cluster -- with, a halt hold is carried out.

[0205] As mentioned above, if field integrated processing of the 1st phase is completed, the 2nd-step field integrated processing will be started. Here, for the reorganization to the field structure of the whole image, label attachment of a meaning is first carried out to the cluster of all images, and it asks for a pair of relation to all the image screens of these clusters.

[0206] As an approach of managing the relation of these pairs, the approach of generating a matrix whenever [dissimilar], the approach of managing as the graph structure, etc. are applicable, and it does not matter theoretically even if it is the any. Even if it makes it which approach, it will ask for the relation between the fields of the arbitration of other blocks from the field of the arbitration of a block of arbitration.

[0207] It considers searching for the information on the boundary section of each field as this pretreatment, and refinding the distance on the screen between these fields.

[0208] As one of them, a profile trace is performed about all fields and the coordinate value of the boundary is recorded. However, in order to match the location on a field and its screen, the coordinate value of one pixel in the field shall be obtained from the label of the root node of a binary tree which expresses like an integrated fault.

[0209] That is, when 1-pixel one cluster is made into an initial state, a label which corresponds to a meaning from the coordinate value shall be assigned to each pixel (refer to advanced technology). that from which the minimum distance between the fields of arbitration becomes min among the distance between the elements of the arbitration during the set of the boundary coordinate value of these fields -- with, it sets. Here, since what is depended on the graph structure pays its attention only to the thing of an adjoining field, i.e., distance zero, when a profile trace is performed about the field of the arbitration of a block of arbitration and a trace point reaches on a block boundary, it asks for the adjacency during a block with reference to the field on the coordinate value of a block of the boundary which faces it, and its label. An average method, a method of elastic center, the Ward method, etc. can compute whenever [these dissimilar] recursively about the newly generated field pair from the measurement size which constitutes whenever [dissimilar / of each field], and, its cluster.

[0210] With the above procedure, a matrix is constituted whenever [graph or dissimilar] and field integrated processing is performed again. If it was made for hierarchical field integration to be completed in two steps, hierarchical field integration will be ended in the phase where the cluster was unified by one in field integrated processing in this 2nd step.

[0211] And in order that the unified field may enable it the to follow later what it sometimes came out and became in field integration Since hysteresis management by the binary tree is carried out and it is made to carry out hysteresis management including the information on each element, such as lightness of the occasional cluster integrated, a hue,

saturation, and a coo inate Using the information on this hysteresis management, the field extract of the request which caught synthetically c ch element, such as lightness of an image, a hue, saturation, and a coordinate, is enabled.
[0212] This invention divides or blocks the image of a processing object in a proper unit as mentioned above. Field integration in the 1st step is carried out for this thing divided or blocked to a unit. After field integration in this 1st step ends, while adjusting these first stage cluster, treating as an image for the one original screen, using an image [finishing / this processing] as an initial cluster and performing field integration in the 2nd step The hysteresis of integration is saved with the color component information on the occasional cluster, and it enables it to divide the field part of a request of an image by following the hysteresis of integration, getting to know the cluster which presents the information on a desired color component, and extracting this.
[0213] In this invention, by dividing or blocking the image of a processing object and performing field integrated processing, the number of the pixel, cluster, and field dealt with at once for every field integrated processing was restricted, and it has improved so that data processing may become possible also in the small computer of a storage resource by this.
[0214] That is, after terminating at once activation (processing which extracts the configurational relation and structure of global contrast of distribution of the color on the screen in a natural image) of the hierarchical field extract in a natural image to a full screen, even if it only manages adjoining field relation according to the graph structure, the storage resource of a considerable amount is needed. For example, though about 4 contiguity is only managed, the combination of adjacency is set in the image of an every direction (hxw) pixel. 2hw - (w+h)
It becomes. This will be set to hwC2 =hw (hw-1) / 2 if the combination of all pixels is dealt with (when using a matrix whenever [dissimila]), the max of a pixel pair which generates the former and must be managed is proportional to the total number of pixel clearly, and, as for the latter, the maximum number is proportional to the square of the total number of pixels. When it is going to realize using the graph structure, from per [200] cluster pair, the storage capacity of 300Byte( ) is needed and the storage capacity near the 100MByte is still needed also in about 512*512 image.
[0215] If processing speed is thought as important when processing a vast quantity of data with a computer, Lycium chinense will be desirable to the primary storage (main memory) of a computer in data. And securing the memory of the above storage capacity as a primary storage has economically large constraint for preparing storage capacity like this as a primary storage from there being reality which says that the cost of a storage resource at present is expensive on the other hand, although it will not be an impossible figure at all if it catches with the view called implementability. Moreover, although it is also possible to use virtual memory instead of a primary storage, since it becomes a vast quantity of overhead and the processing time will increase rapidly, a problem is large [transfer of data with enternal memory] in respect of practicality.
[0216] Moreover, when managing only the pair of the pixel which will carry out contiguity according to the graph structure soon, since there is no information on whenever [dissimilar / of the pair of all pixels], the applicability of the approach (the combination-approach) of computing whenever [dissimilar] recursively is limited.
[0217] So, in this invention, the image of a processing object is divided or blocked in a proper unit, after it carries out field integration in the 1st step to a unit and field integration in this 1st step ends in it this thing divided or blocked, an image [finishing / this processing] is collected, it treats as an image for the one original screen, field integration in the 2nd step is performed, and the extract of the target field is enabled. In this invention, by dividing or blocking the image of a processing object and performing field integrated processing, the number of the pixel, cluster, and field dealt with at once for every field integrated processing could be limited, and it was made like, and it has improved so that data processing may become possible also in the small computer of a storage resource by this.
[0218] For example, suppose that a screen is divided into the block used as the unit of 32x32 (1024) pixel. A pair of combination of the pixel generated as a matrix whenever [dissimilar] 523776 pieces -- becoming -- a pixel pair -- the amount of data per one -- temporary -- 50Byte(s) (whenever [dissimilar], as compared with the graph structure, since it is easy, the way of matrix DS) The storage capacity needed for constituting this matrix on a primary storage if the storage resource which one batch takes is small is about 25 MByte(s). It becomes and becomes the magnitude of the storage resource of a standard computer. Moreover, if a batch, i.e., the number of pixels, decreases when using a matrix whenever [dissimila], the combination of a pixel pair will decrease in proportion to a square. (When the graph structure is used on this condition. in the early number of a pixel pair, the initial complement of 1984 pieces and a storage resource serves as about 0.55 MByte(s)) .
[0219] It is not made to complete. but a halt hold is carried out in the place where whenever [dissimilar], or the number of clusters reached suitable conditions, and field integration with each block saves such integrated hysteresis, and performs this processing to other three blocks of all. In the phase which this processing ended to all blocks, relation

with other fields of other blocks of the field of the arbitration of a block of arbitration is investigated, about all images, again, a matrix is constructed whenever [graph structure or dissimilar], processing of hierarchical field integration is performed again, and field integration is completed.

[0220] It faces that a unit of field integration with each block performs 2nd field integration, and it becomes the point to make it decrease to the number of fields which is extent which can construct a matrix whenever [graph structure or dissimilar] by the whole image, and distribution of whenever [dissimilar / of each cluster pair] serve as homogeneity as much as possible.

[0221] Moreover, although explanation in the example which divided the image in the unit of a square block was given, the partial part of the screen of an image may be suited, and if a block is not cared about as a rectangle of arbitration, it may be an indeterminate form. Moreover, also when a block can realize a hierarchical field extract at once by one, it shall treat as a special form of this method.

[0222] When the hierarchical field extract of an image becomes realizable also in a computer with a comparatively small primary storage and also it uses a matrix whenever [dissimilar] about processing speed by this invention, processing effectiveness comes to be improved by leaps and bounds by making a block unit small.

[0223] Moreover, it limits to a specific image part by dividing one screen into a block, and it becomes possible to perform hierarchical field integration. Moreover, it comes to be able to lessen storage capacity of the field integrated hysteresis generated with this, and it also becomes possible to exclude unnecessary field integrated hysteresis depending on processing.

[0224] Moreover, according to the graph structure, it combined and constraint was lost to the calculation approach of whenever [dissimilar] by the target approach / for which constraint was received sharply] because it can respond now to a matrix whenever [dissimilar].

[0225] In addition, without limiting to the example mentioned above, it deforms variously and this invention can be carried out.

[0226]

[Effect of the Invention] As mentioned above , when become realizable also in a computer with a comparatively small primary storage about the processing which extract the configurational relation and structure of global contrast of distribution of the color on the screen in a natural image according to this invention as explain in full detail , and use a matrix whenever [dissimilar] about processing speed , the effectiveness of processing effectiveness be improve by leaps and bounds be effective by make a block unit small .

[Translation done.]

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing for explaining the example of this invention, and is the block diagram showing the configuration of the image processing system concerning one example of this invention.
[Drawing 2] It is drawing for explaining the example of this invention, and is a flow chart for explaining the outline of the overall procedure concerning one example of this invention.
[Drawing 3] It is drawing for explaining the example of this invention, and is a flow chart for explaining the detail of the field integrated processing concerning one example of this invention.
[Drawing 4] It is drawing for explaining the example of this invention, and is a flow chart for explaining the detail of field integrated processing in the 2nd step concerning one example of this invention.
[Drawing 5] Drawing in which being drawing for explaining the example of this invention, and showing the example which divided the image of one sheet into the block with the rectangle of fixed size, and carried out division imaging.
[Drawing 6] It is drawing for explaining the example of this invention, and is drawing having shown the detail of each block (each division image).
[Drawing 7] It is drawing for explaining the example of this invention, and is drawing showing the example of a matrix whenever [dissimilar / concerning one example of this invention].
[Drawing 8] It is drawing for explaining the example of this invention, and is drawing for explaining the structure 140 holding the information-structure object 130 which has the information on the pixel pair of the information-structure objects concerning one example of this invention, and the information on the condition of each cluster.
[Drawing 9] It is drawing for explaining the example of this invention, and is drawing for explaining the structure 150 of the binary tree node concerning one example of this invention, and the structure 160 of integrated status information.

[Drawing 10] It is drawing for explaining the example of this invention, and is drawing showing the condition of a binary tree node at the time of the initial state (1-pixel one cluster) in one example of this invention.
[Drawing 11] It is drawing for explaining the example of this invention, and is drawing showing the example of contents of the structure 150 of the binary tree node in the time of the initial state in one example of this invention.
[Drawing 12] It is drawing for explaining the example of this invention, and is drawing showing the integrated hysteresis binary tree obtained as a result of carrying out field integration concerning one example of this invention one after another.
[Drawing 13] It is drawing for explaining the example of this invention, and is drawing showing the example of the list node structure 170 of the integrated hysteresis binary tree concerning one example of this invention.
[Drawing 14] It is drawing for explaining the example of this invention, and is drawing having shown the situation of field integration of Block 1 as an example.
[Drawing 15] It is drawing for explaining the advanced technology, and is drawing showing the image data concerning one example of the advanced technology, the data of the graph structure, etc.
[Drawing 16] It is drawing showing the form of the value* of a contrast scale value showing the strength which are drawing for explaining the advanced technology and showing one example of the advanced technology. It is drawing showing a color space.
[Drawing 17] It is drawing for explaining the advanced technology, and is a flow chart showing field integrated processing of the image processing system concerning one example of the advanced technology.
[Drawing 18] It is drawing for explaining the advanced technology, and is drawing showing the data of the top-most vertex in one field of the advanced technology, and neighboring data.
[Drawing 19] It is drawing for explaining the advanced technology, and is drawing showing the data of the top-most vertex in one field of the advanced technology, neighboring data, and list data.

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c.
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v.
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technology.
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g the advanced technolo nd is a graph showing the top-most vertices and
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g the advanced techno nd is a graph showing the top-most vertices and
tegrated fault concern e example of the advanced technology.

* NOTICES *

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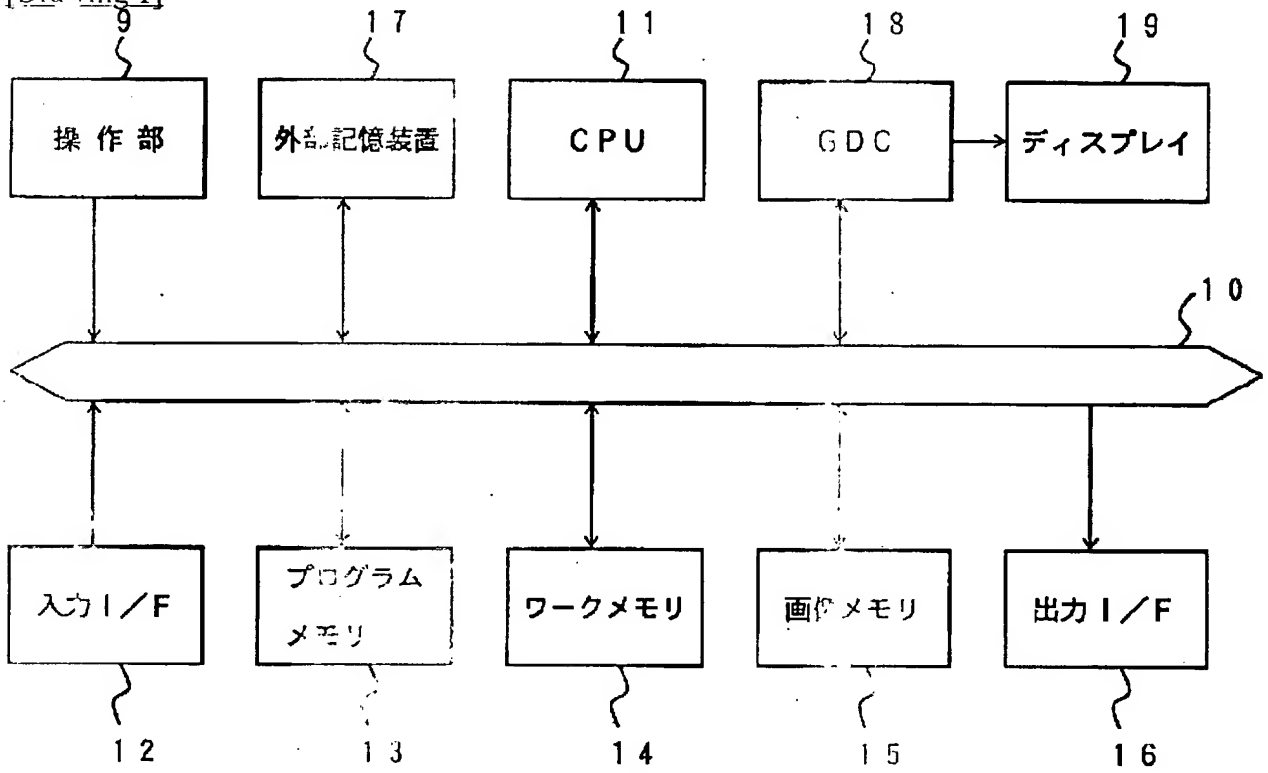
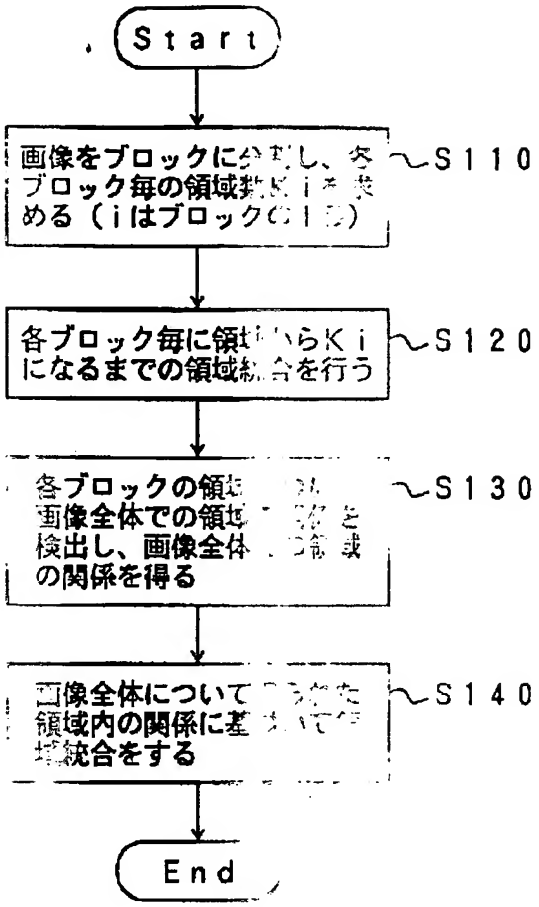
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

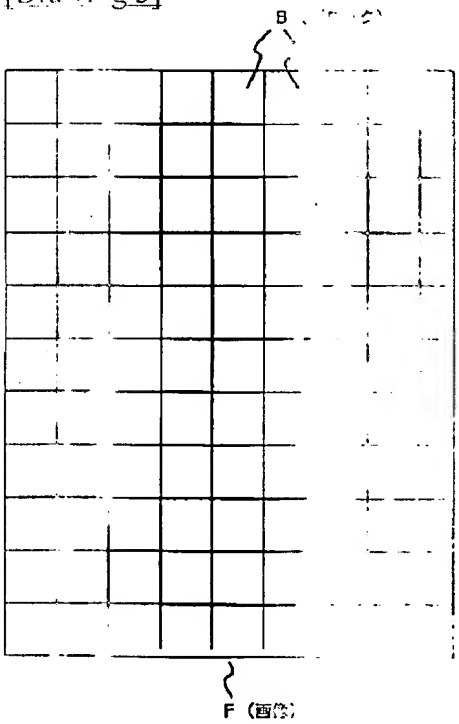
[Drawing 1]



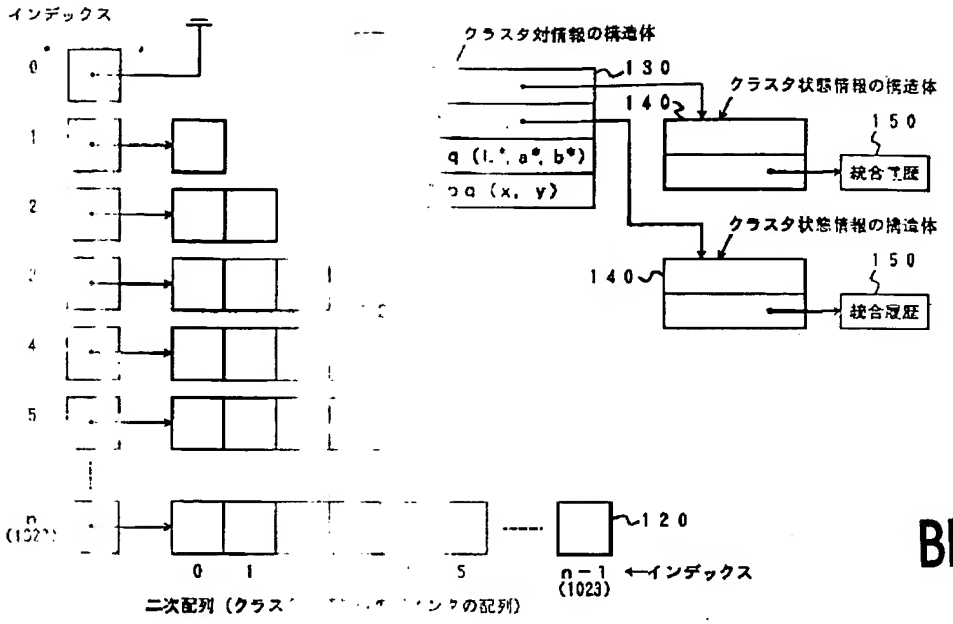
[Drawing 2]



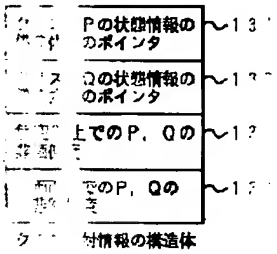
[Drawing 5]



[Drawing 7]



[Drawing 8]



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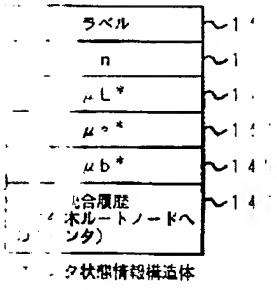
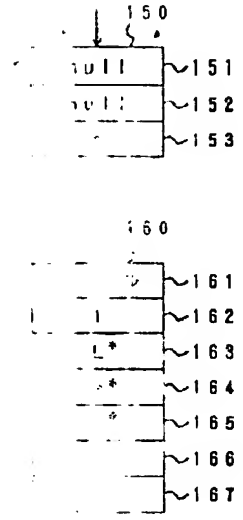


(b)

[Drawing 11]



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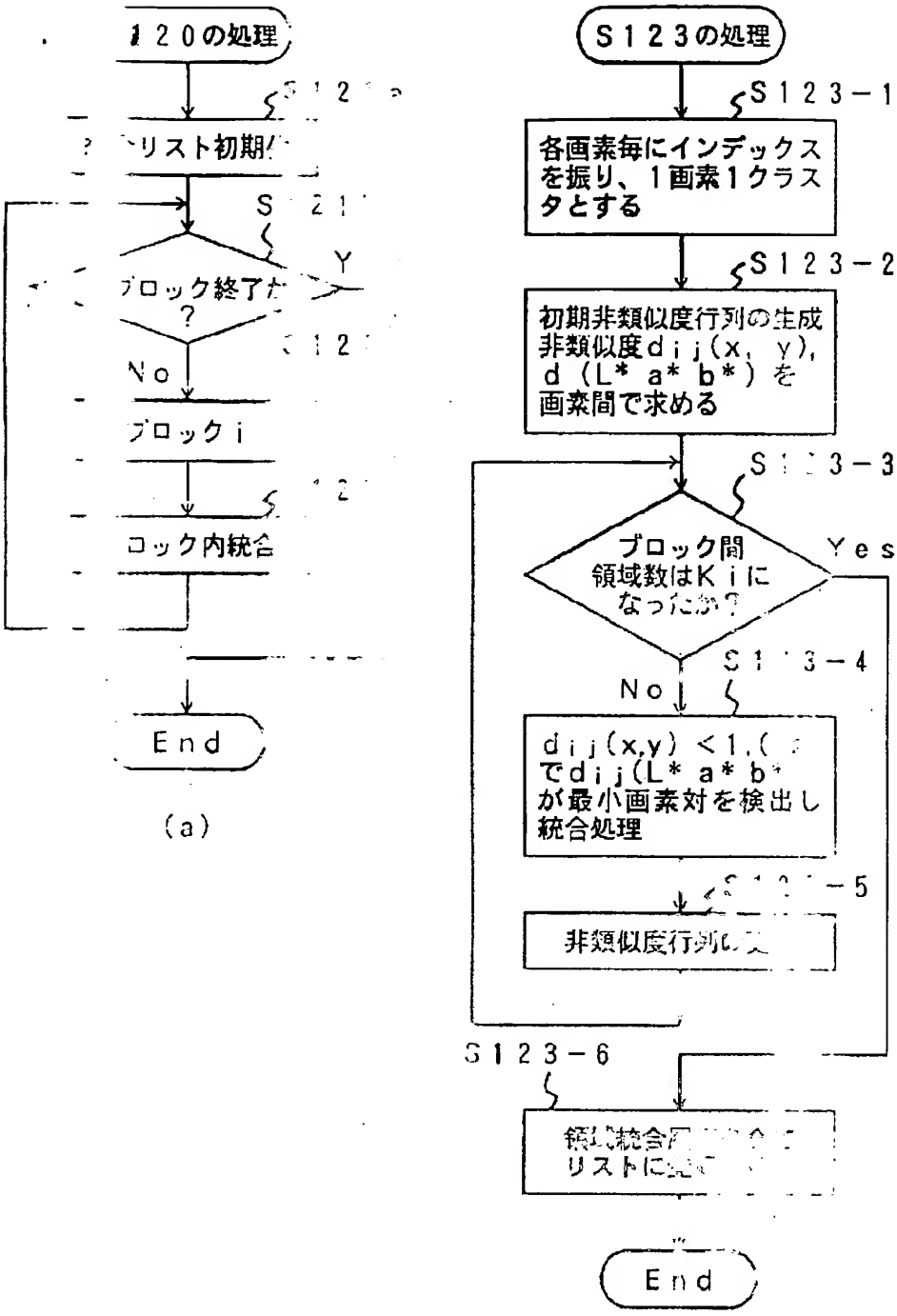

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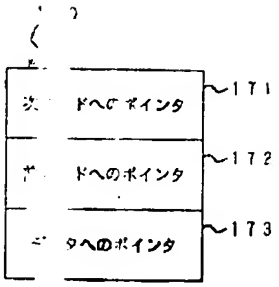
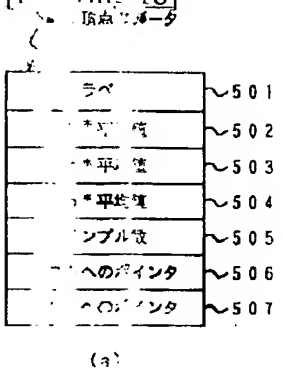


[Drawing 18]



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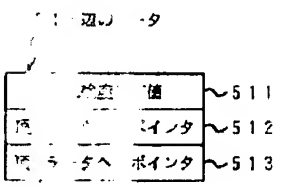
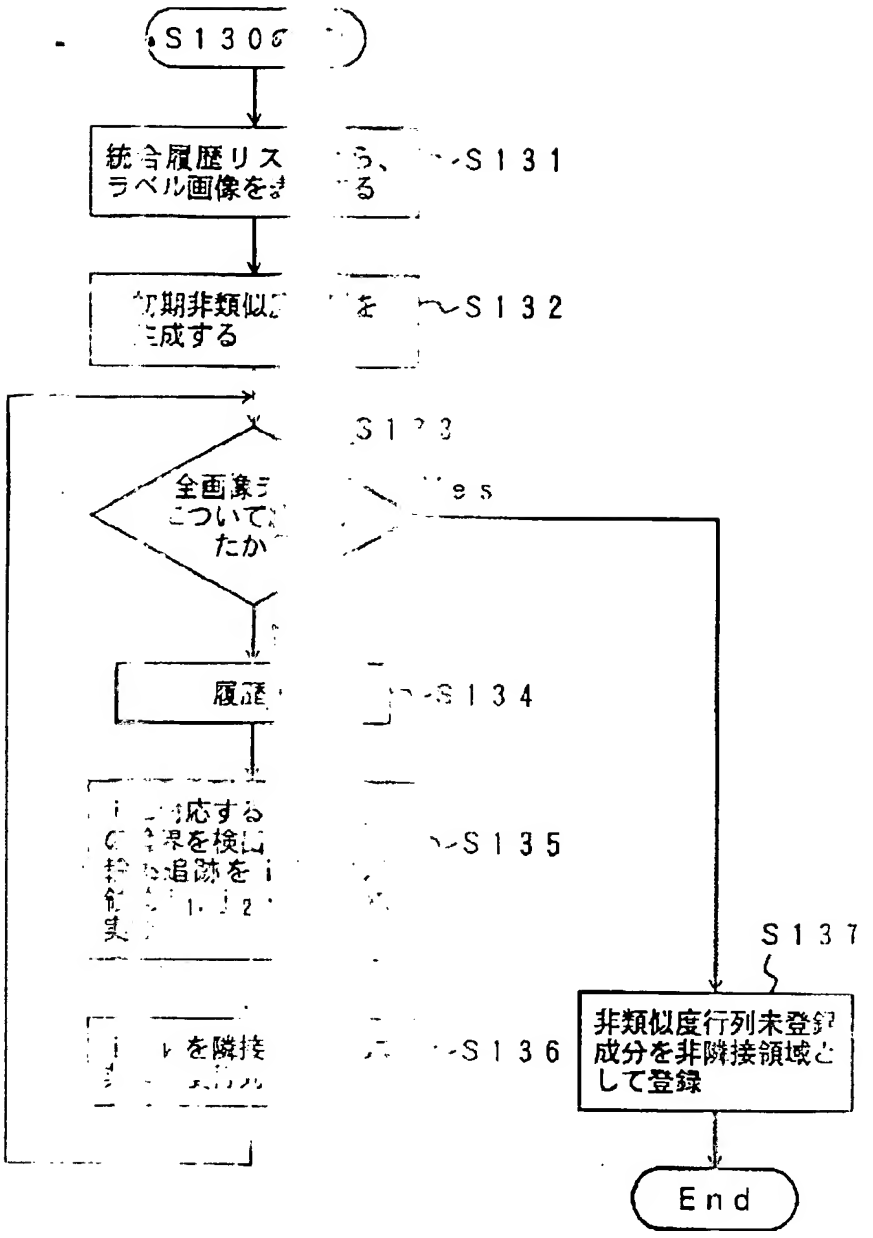
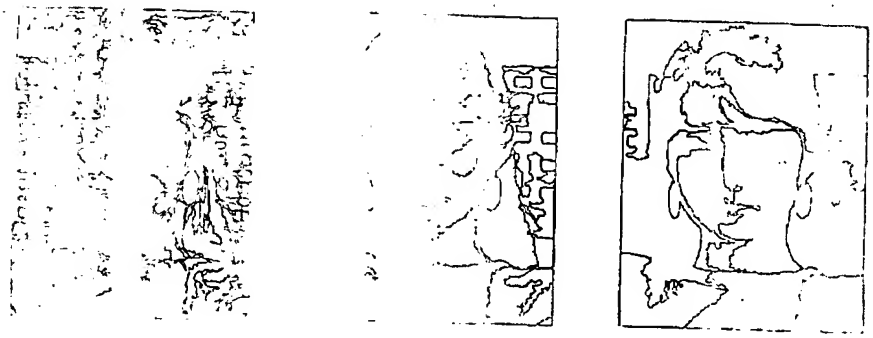


(b)

[Drawing 4]



[Drawing 25]



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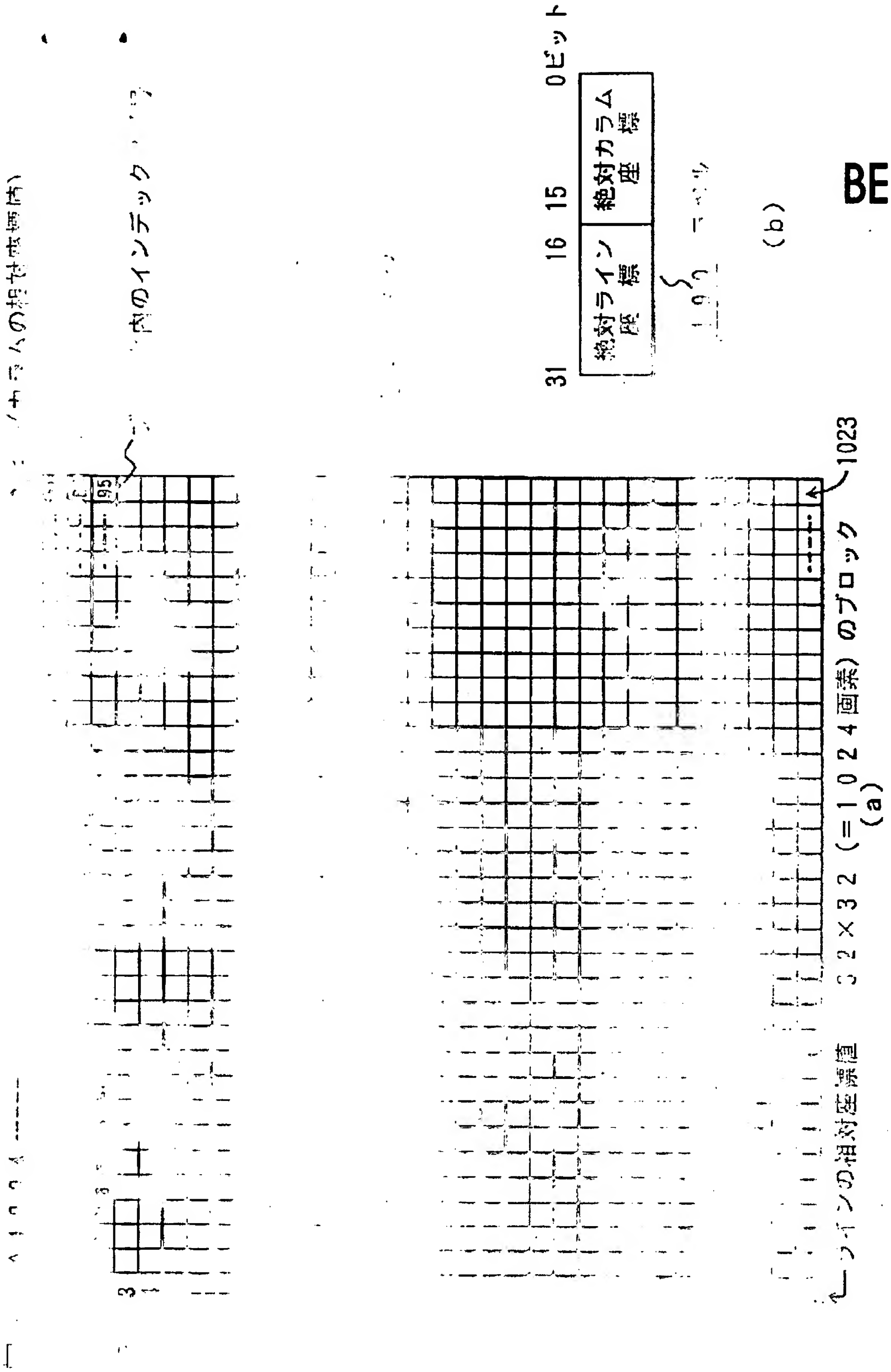

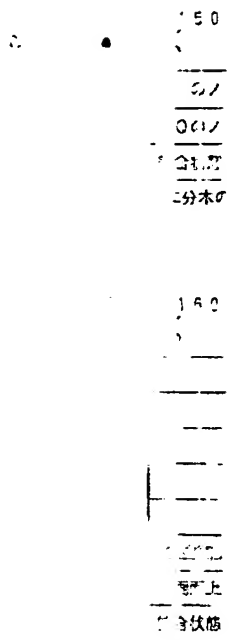

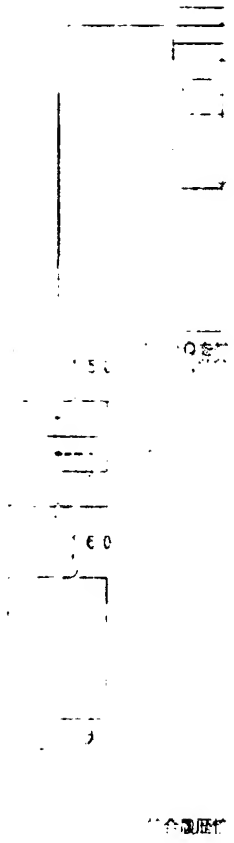

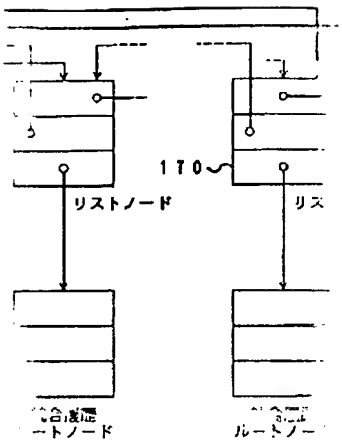

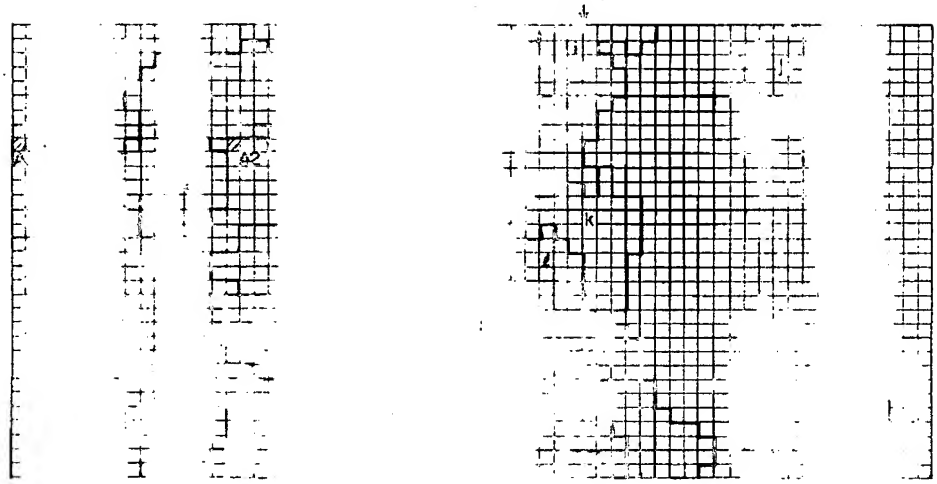

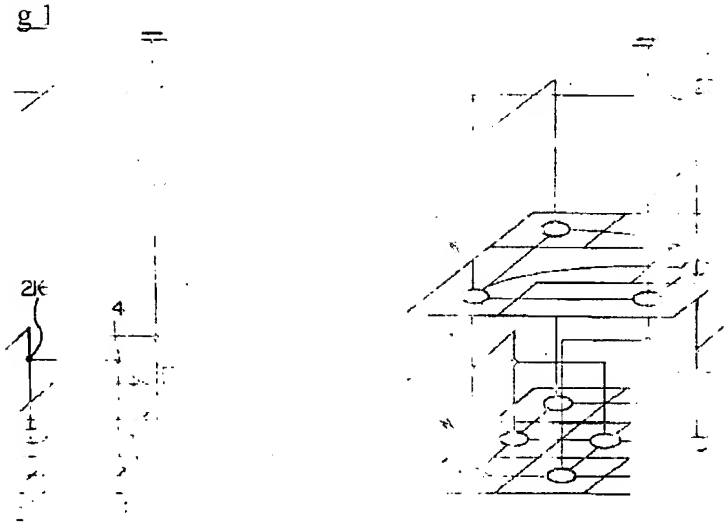

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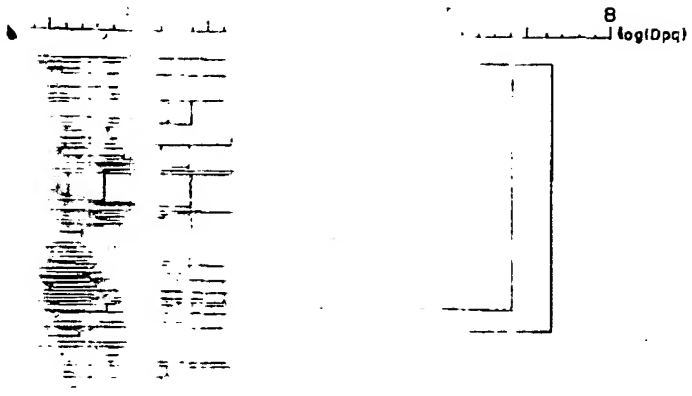

$$= \sum_{j=1}^{m} \sum_{i=1}^{n_p} \left(x_{ji}^{(p)} - \bar{x}_j^{(p)} \right)^2$$

$$= \Delta S_{pq} = \frac{n_p n_q}{n_p + n_q} \sum_{j=1}^{m} \left(\bar{x}_j^{(p)} - \bar{x}_j^{(q)} \right.$$